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Engineering News-Record

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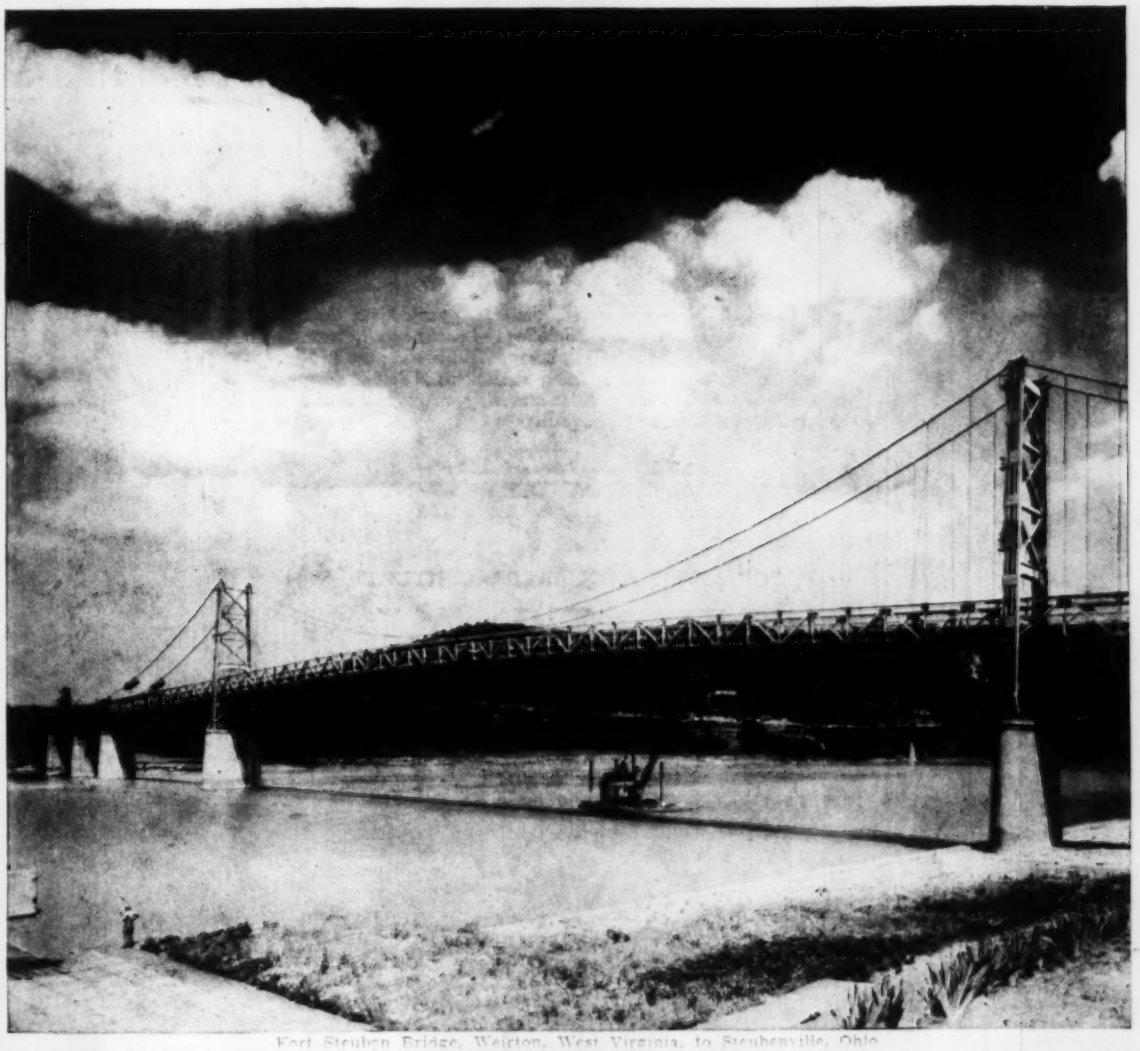

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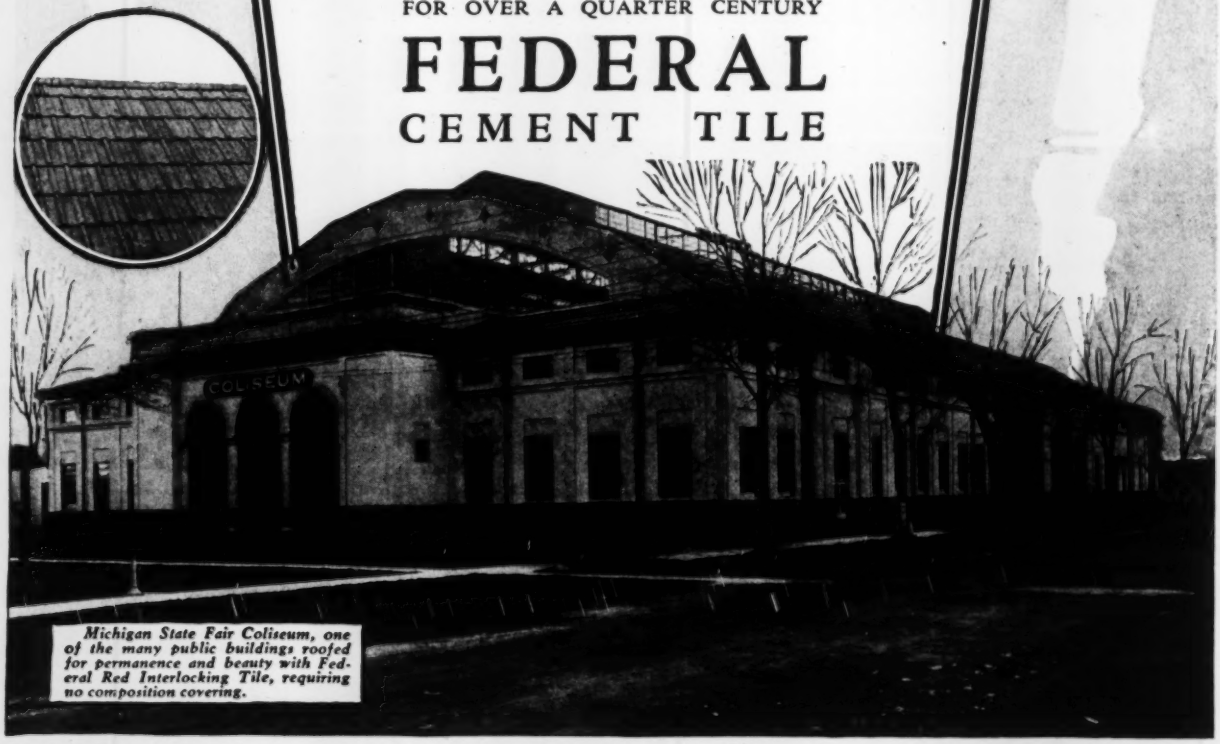

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New York, August 30, 1928

Engineering News-Record

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COMING:

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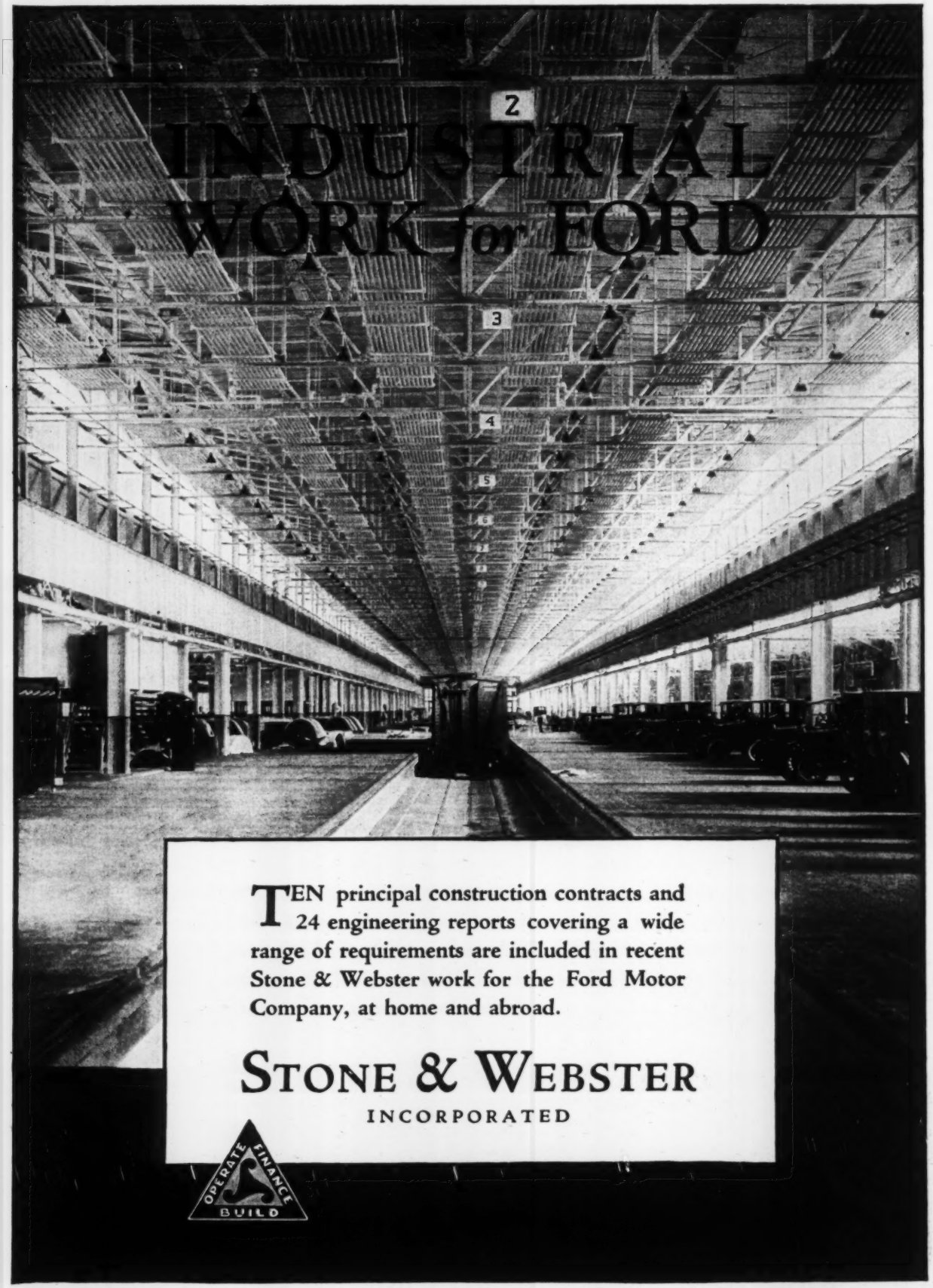

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Editor

Volume 101 NEW YORK, AUGUST 30, 1928 Number 9

Regional Communities

SIMULTANEOUS decentralization and growth are rapidly creating new communities and of what heretofore were self-centered cities and suburbs. Regional communities are taking shape, each with a city as its focus but having needs which the city alone cannot supply. The causes of this new development are various; they include rural mail delivery and the parcel post, the cheapening of automobiles to the degree of making them available to all, the extension of commercial delivery systems and, to name only one more, the evolution of motor-bus transportation. As these agencies will have continuing effect, regional communities and their problems are bound to grow. Serious attempts have been made in a number of cases to take care of the more pressing regional needs by city effort, as by extension of water supply to the extramural population. In other localities the county is endeavoring to meet the situation in the matter of roads, bridges, sewers and parks. But in general these efforts do not go to the root of the matter. The result is a situation of great interest and importance to all engineers concerned with municipal problems. New forms of administrative organization will have to be found to take up the problems of regional communities, and these problems themselves will have to be outlined, discussed and their various possible solutions tried out. A new and highly interesting department of civil engineering is thus crystallizing. Studies of both the general problem and of typical regions, bringing out the nature of the new problems and how they are being solved, have been made by *Engineering News-Record*, and the results will be given in a group of articles publication of which will soon begin.

A Safety Program

WITH a special committee on safety in construction about to begin its work under the American Engineering Standards Committee, the annual safety congress which this year convenes in New York City, Oct. 1 to 5, should be made an occasion for constructive effort to determine upon a committee program in which all construction agencies can join. Held under the auspices of the National Safety Council, the congress is "dedicated to the presentation of ways and means for curtailing accidents." The construction section of the council in one of its three sessions will meet with the New York Building Trades Employers Association, an organization which in the last year or two has made a record among builders' organizations for its accident prevention work. Here should be opportunity for calm discussion of differences in procedure and in objectives, to smooth out a situation that at present promises no good to the cause of safety in construction. It is not the purpose here to point out again where the differences lie; the important task is to put behind the Engineering Standards Committee work now in hand a unified effort. It may be that this will call for compromises, but we believe that the opposing elements are in closer agreement than they realize. Both partisans are honestly seeking the same result—namely, ways and means of curtailing accidents in construction. Mutual understanding and agreement, then, should be possible. In any event, they should be attempted before the Engineering Standards Committee gets settled to its difficult and important task. The meetings of the construction section of the National Safety Council on Oct. 1, 2 and 3 offer a forum for debate and action which will have great influence with the men and agencies who for seventeen years through these safety congresses have worked to reduce the hazards which industry places on human life. All persons and organizations interested in the movement for construction safety should take the opportunity to let their opinions be known.

The Price of Congestion

LAST Friday New York City paid dearly for the congested condition into which it has permitted rapid-transit facilities to develop. A rush-hour train jammed full of people was derailed and sent crashing against a concrete partition wall between two tracks. People were crushed to death in the car which took the brunt of the shock and others were thrown to the track from the crowded vestibule of the car which followed. As a result, sixteen persons are dead and many others are seriously injured. Whether the defective switch which caused the accident was an outgrowth of the congested condition of the subway system is open to question, but beyond doubt a number of the casualties are chargeable directly to the crowded condition of the cars. With two people crowded into the space that one should occupy, and with the vestibules full to overflowing, such an accident could not but result in a great increase in loss of life over what would have happened had the cars not been so overcrowded.

Rules for Greater Safety

NEW YORK CITY has long claimed that its subways are the "safest railways in the world," and the claim is nearly as true today as it was before Friday's accident. Millions of passengers are carried month after month with so few serious accidents as to make the ratio of passengers killed or injured to those carried in safety a negligible quantity. But with the ever-increasing density of travel on the subways the matter of safety precautions takes on a sharply marked importance. Conditions tolerated in the past which tend to reduce the margin of safety should be reconsidered in the light of present conditions to determine whether they cannot be eliminated. This is true of any railway. It finds expression in the costly changes which are made by many railroad companies to do away with dangerous curves, track arrangements or crossings. But it is much more imperatively

true of congested rapid-transit service. The present accident occurred at a facing-point switch, always a potential source of danger and only rarely unavoidable. Not infrequently facing-point switches continue in service long past the time when they cease to be compatible with safety, on the ground of greater operating efficiency. In the New York case, it has been claimed, moving the switch from its present position would measurably decrease the peak-load capacity of the line, so close is the headway at which the trains operate. Consequently the switch holds a key position between increasing safety and increasing congestion. Under such circumstances it should not be handled for maintenance or repair in any haphazard manner. Once any facility upon which the safety of so many people depends shows any indication of being out of order, only iron-clad rules can insure against accident. Unless such rules are put in force, and manipulation of defective trackwork in rush-hour intervals is abolished, the accident will not have led to greater safety for the future.

Improving Credit Practices

A REFORM in credit practices is promised by the recent conference in Chicago of the Associated General Contractors and construction equipment manufacturers and distributors. There was frank confession that a vicious condition has resulted from the common demand by contractors for long extensions of credits and the general willingness of manufacturers and dealers to meet this demand. The decision was reached to join forces in devising and applying a remedy. And finally a general procedure was agreed upon for advancing the movement.

The conference at Chicago on better credit practices is a further step in the work which the Associated General Contractors, after much preliminary feeling about, set for themselves at their annual convention at West Baden last January. Taking action again at their spring meeting in Washington, they organized with subcontractors the Allied Construction Industries Committee of the Building Division and laid the foundation in the Engineering Construction Division for a series of conferences with equipment manufacturers and materials producers. It is not useful at present to recount the steps which led to the initial conference, but so much of the background as has been given is necessary to an understanding of the earnest work in hand.

In approaching the task of the Chicago conference, a cause for action had first to be established. Fortunately the evidence was so plain that there was little difficulty in getting mutual acknowledgment. The next step was agreement to co-operate in bringing about a reform, mutual confession having by that time put both parties in a mood to join hands. The final step was a plan of operation. In developing this it was wisely realized that educational work had first to be greatly extended, and it was determined for the present to continue conferences with other groups of manufacturers and distributors until the gospel of credit reform had been disseminated throughout the industry. Obviously repetition elsewhere of the success had at Chicago would soon round up manufacturers and contractors in great enough force to create a reform movement of dominant strength.

Contractors, and perhaps to some extent equipment dealers, believe that the chief obstacle to the movement is a fear that it may discourage the customary time-payment plan. This fear seems unwarranted. The time-payment plan is too well established, too thoroughly justified economically and has been too long the benefactor of contracting to be interfered with. There is, however, a logical limit to the period of payment if the practice is to be kept sound. It is the overextension of time payments that needs to be restricted. And particularly it is desirable to restrict the now common type of transaction in which no down payment whatever is made. Both of these reasonable safeguards to time-payment credit practices are being flagrantly disregarded, and in consequence manufacturers lose thousands of dollars in repossession actions, while legitimate contracting is hurt by the influx of contractors who lack credit and experience and who bid low and recklessly in proportion.

What device for handling time credit will come out of the co-operation of contractor-buyer and manufacturer-seller is uncertain. The matter of greater importance at the moment is that a sound partnership shall be established between the two to plan and execute some device. This is the vital task of the moment, and it cannot be undertaken too energetically if it is to succeed. The Associated General Contractors have begun the work. It should be taken up by other contractors' associations and by all associations of dealers in materials and machinery used in construction. Unless construction as a body corrects its practices of buying and selling on credit they will be corrected by individual failure and bankruptcy proceedings. It is time, therefore, to get to work with those who have undertaken leadership in exercising concerted action.

Size and Value

AMONG engineers who write or inspire articles on technical subjects there is often an underlying feeling that the interest in a job of design or construction is in direct relation to the size of the job. A big bridge, building or power plant is assumed to be necessarily more interesting and more deserving of notice than a smaller one. The fact is, however, that the smaller structure often has at least equal interest and instructional value to the larger. Though large structures are likely to include special features, they are more amenable to simplification and systematization, while smaller works frequently retain the difficulties of adaptation and improvisation associated with pioneer operations.

The size factor is present in a long bridge; yet if the spans are not unusual, if the foundations and erection are in accord with common practice, its description can carry little more than casual interest. Smaller bridges are much more apt to involve individual problems and difficulties, and their description may form a real contribution to engineering knowledge. In the same way a large skyscraper building may be marked by simplicity and conventional details, while a smaller building may tax the ingenuity of the designer and constructor. Among recent practical examples is the case of a short steel viaduct which offered a variety of structural and erection problems, and the instance of sewage-works in two small cities of which one presented exceptional construction difficulties while the other contained an unusual variety of designs and construction methods. The value of these works as models of practice and as subjects for technical thought and discussion was quite unrelated to their size.

Engineering News-Record seeks to present to the engineering profession information of value in practice or

useful for reference and record. To carry out this purpose effectively requires the active co-operation of its readers as unofficial members of its editorial staff, a co-operation which has been responsible for the upbuilding of this journal during the half-century of its life. For this reason we feel warranted in pointing out to our collaborators the often misunderstood importance of size of work, and the fact that the small job or structure may be better worth discussion than the large.

Federal Aid and Class Relief

THOSE who see in federal aid a menace to state sovereignty because, as they allege, federal aid goes hand in hand with federal control of state activities would do well to follow closely what is happening in England as regards national contributions to municipal expenditures and accompanying central control of city and town affairs. No deductions should be drawn without taking into account the differences between British and American systems of taxation and government and the real nature of federal aid in America.

For many years past "grants in aid," virtually contributions from the British treasury in relief of local "rates" (taxes), have been growing in number of objects and in sum total of money. Naturally enough, they are accompanied by stipulations of conditions to be met by the municipal governments. An instance of long standing is the payment by the central government of half the salary of local medical officers of health provided the appointees meet the approval of the Local Government Board, now the Ministry of Health. Since the war these "grants in aid" have increased materially and with them so has central control. In Griffith's two-volume study of "City Government in the United Kingdom and the United States," reviewed on p. 107 of our issue of July 19, 1928, the rapid increase in central grants and control is held to be destructive of municipal government in Great Britain.

Legislation proposed since Mr. Griffith's book was written will, if enacted, make far worse what Mr. Griffith believes is already a bad matter. As an aid to British industrial establishments in their struggle to meet post-war conditions it is proposed to have local governments remit 75 per cent of the local rates as a relief to industry, the amounts to be made up to the local treasuries by the national treasury. If this is done, the grip of Parliament and the central administrative bureaus on British local government will be tightened still more and the interest of town dwellers in their local governments be still less than at present.

In the United States there is no federal aid to or control of municipalities. The nearest approach to either is special advice or assistance extended by federal administrative agencies on application by the localities, or by the states in which they are located, as in the case of epidemics, floods or other disasters. Our federal aid, comparable with the British "grants in aid" to municipalities, is extended, if at all, to the states, and as a rule must be matched by state funds dollar for dollar or better. Our federal aid naturally carries with it federal supervision designed to insure that the money is wisely expended, but this supervision, notably in the case of federal aid to highway construction—the chief example of federal aid in America—starts with insistence on a proper state administrative agency to conduct the work for which the national government provides money. Federal highway aid, it may be noted, is directed to covering the country with a network of improved highways.

American municipalities receive no local taxation relief from the state treasury, after the increasingly prevalent British fashion. The states do pay to some of their minor civil divisions large total sums for educational and highway purposes, but these come for the most part from taxes on property and from automobile licenses and gasoline taxes. Federal contributions to highway construction are but a small part of the large total derived from national taxation of automobiles and their accessories. In other words, in the matter of highways, our national contributions to the states and our state contributions to the cities—when the cities get anything—are largely mere redistributions of funds, or of a part of the funds, collected from the users of the roads. Redistribution is also practiced in state aid to local education, only here much of the money comes from the general property tax, collected locally by the town, city or county as agent for the state, and coming back, in part, to the locality, but often if not generally based on local school attendance.

While the net effect of our federal aid to states and our state aid to municipalities may be to lessen state and local taxation—assuming that the expenditures would be made if there were neither national nor state aid—that is not the primary object. The main object is efficient service—roads or schools—for all parts of the nation or of the state. The means to that end are contributions according to ability or according to use.

England's plight in local taxation comes largely through raising money for local purposes by taxes on the "rental value" of property and letting landowners, as such, go free. Since the war, tenants have had to pay "rates" from half to more than the entire rental values. No wonder they become "rate conscious" and oppose local improvements. Before and since the war, according to Mr. Griffith's book, Parliament and the administrative boards have tried to meet this "rate resistance" and the consequent growing lack of local improvements and service by "grants in aid," so as to provide money without burden to the ratepayers. This, with the accompanying measures to see that the grants are spent according to the standards of the grantor, has led to a usurpation of local government by the central authorities and less and less citizen interest in local government.

Along with all this has been the British industrial depression. Owners of manufacturing plants, it appears, have shown an increase in their "rate resistance." To meet this and the present depressed state of British industry, the government proposes to compel cities and towns to remit 75 per cent of their local taxes, as we would say, on industrial establishments, and to make up the amounts from the national treasury.

Thus, so far as British towns are concerned, not only will land be free from local "rates" (taxes) but industry will be 75 per cent free. Who, then, will bear the burden? To say that it will fall on the national treasury does not answer the question. Someone must provide the 75 per cent remitted. Ultimately it must fall on the wage earner and upon capital.

We see in the British conditions here sketchily outlined, no reason to worry over current methods of federal aid to states and state aid to municipalities in the United States, but an indication of need to be watchful of what happens under it elsewhere when class interests dominate, as has been the case for so long in England.

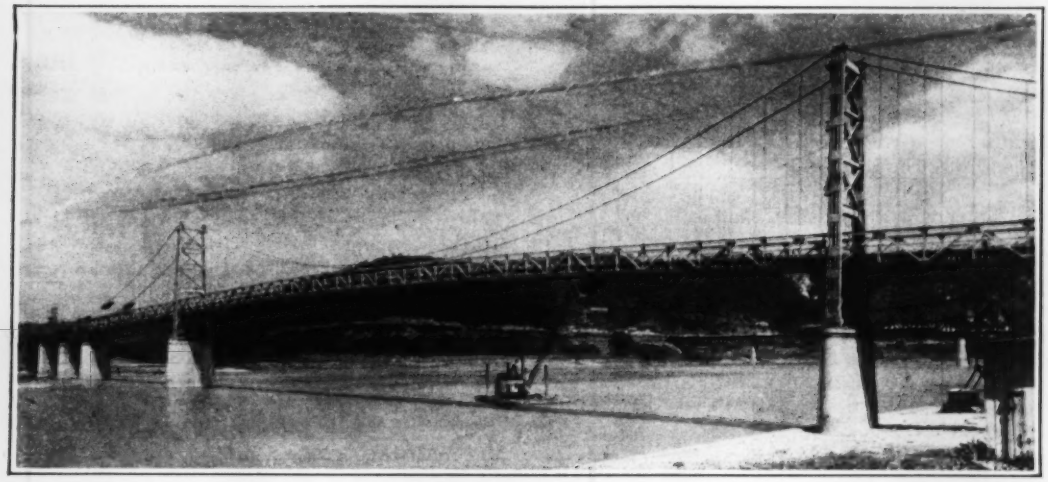


Fig. 1—Fort Steuben Suspension Bridge Over Ohio River

Ohio River Suspension Bridge at Steubenville, Ohio

Fort Steuben Structure With 689-Ft. Center Span Presents New Practices in Suspension Bridge Engineering; Namely, in Land Cable Spinning, in Strand Transfer and in the Use of Rolled Steel Sections for the Main Towers and the Web Members of the Stiffening Trusses

By George F. Wolfe
Bridge Engineer,
The Dravo Contracting Company, Pittsburgh, Pa.

Bridge Activity in the Ohio and Mississippi river valleys is unusually pronounced. No less than half a dozen bridges have recently been completed or are under construction over each of the rivers. Some of the new bridges over the Mississippi River are located at Cairo, St. Louis (Chain of Rocks), Vicksburg, Quincy, Ill., Memphis, and Cape Girardeau, Mo. Over the Ohio River, the unusual Gallipolis-Point Pleasant bridge and crossings at Paducah, Ky., Cincinnati, St. Marys, W. Va., and Louisville are completed or under construction. The Fort Steuben bridge over the Ohio River between Steubenville, Ohio, and Weirton, W. Va., is the second of a series of bridges being built by The Dravo Contracting Company. The first of this series, at Portsmouth, Ohio (*Engineering News-Record*, Oct. 20, 1927, p. 620), represented the entrance of this company into the field of suspension bridges as a builder of both substructure and superstructure. Based on this initial experience there were developed on the Fort Steuben bridge several special design features and erection methods which resulted in a marked saving in time and cost. These, together with general data on the design and construction of the bridge, are presented in the following article. Other Ohio and Mississippi river bridges which incorporate in their planning or erection important practices and details will be considered in other articles to be published in the future. —Editor.

A number of new methods in design and erection were inaugurated on the recently completed suspension bridge over the Ohio River between Steubenville, Ohio, and Weirton, W. Va. Chief among the design characteristics is the use of fixed-base main towers fabricated entirely from rolled steel sections, and the further extensive use of such sections for the web and floor members of the stiffening trusses. Conditions on the Ohio end required an unusually sharp bend in the cable after it passed over the cable bent, so the cable construction was stopped at the cable bent and eyebar construction was substituted; for symmetry and consistency, the same type of construction was used on the West Virginia end of the bridge.

The interesting features of the erection work center around the method of cable spinning on land on the West Virginia approach and the expeditious method of strand transfer; around the use of a 150-ft. tower boat for erecting the main towers, and the use of a standard derrick boat equipped with a special 130-ft. boom for erecting the stiffening trusses and floor system of the main span and West Virginia side span.

The bridge has a main span of 688 ft. 9 in. and side suspension spans of 283 ft. each. The cable-bent tower at the Ohio approach is the end of the structure, while on the West Virginia side there are three 90-ft. and one 60-ft. plate girder spans. The floor is of reinforced concrete carried on steel stringers, with a clear width of roadway of 20 ft. 3 in. The main-span cable sag is 70 ft., or approximately 1 : 9.85 of the span; the side-span sag was made 11.818 ft. in order to balance the horizontal cable pull between main and side spans under full dead load. The stiffening trusses, which are 14 ft. deep, or 1 : 49.2 of the main-span length, are spaced 24 ft. apart and are hung directly below the cables. They are of the continuous type.

Main Towers—Fixed towers were adopted in order to eliminate certain erection delays and difficulties that were experienced with the rocker towers on the Portsmouth bridge. (*Engineering News-Record*, Oct. 20, 1927, p. 620.) However, in order to have all the advantages of the rocker towers during erection, since it was necessary to incline the towers several inches toward shore at the start of erection, an I-beam grillage consisting of nine 15-in. 55-lb. beams 4 ft. long was embedded in the top of the pier under each tower leg. A 4x16-in. steel billet 5 ft. 8 in. long with the top machined to a 6-ft. radius (Fig. 3) was placed on top of the grillage to serve as a temporary rocker. Adjustable steel wedges were used under the sides of the steel base plate and served to keep the towers in any desired position during erection of the suspended spans and the placing of the concrete floor. The wedges were finally driven tight and all remaining space under the base was grouted. The bases of the tower legs were specially reinforced with heavy diaphragms and filled with concrete to carry the dead load on the line contact surface during the erection period. The anchor bolts were adjusted daily until the tower reached a vertical position.

The design of the towers was dictated by a desire to simplify the shop fabrication. This resulted in the adoption of the new Carnegie beam sections. The parallel surfaces of flanges in these beams made them readily adaptable for the splicing of main joints. The design as used consisted of four 30-in. Carnegie beams placed with the webs parallel and connected at the center of the webs by two 15-in. Bethlehem beams and one 24-in. standard beam in the lower tower section, which weighs 850 lb. per linear foot. The upper half of the tower legs was made up of similar beams of slightly lighter section. All shop riveting was $\frac{7}{8}$ in. and all splices and field connections were reamed for 1-in. field rivets. The towers were entirely assembled in the shop, and all reaming was done with the towers completely assembled, thus eliminating all field reaming.

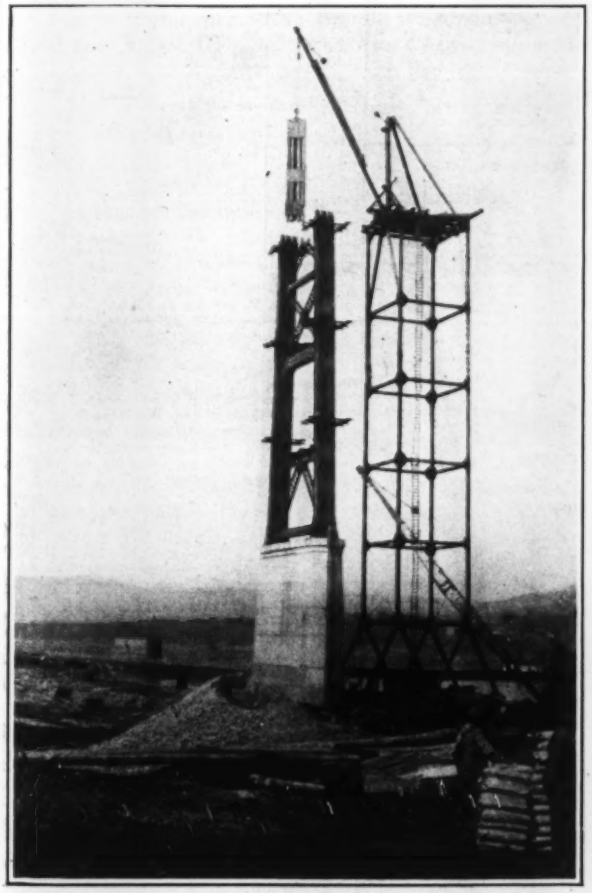


FIG. 2—FLOATING DERRICK WITH 150-FT. TOWER RAISING MAIN TOWER SECTION

The erection of each main tower took only six actual working days. This performance was made possible by the use of a floating erection tower derrick made up of a stiffleg derrick mounted on a wooden tower carried on two steel barges, as shown in Fig. 2. The barges were of the flush deck type 24 ft. wide, 102 ft. long and $6\frac{1}{2}$ ft. deep, and were fastened together by drilling holes through the sides and connecting with bolts. The tower, 24 ft. square and 150 ft. high, was composed of 12x12 timbers throughout, with $1\frac{1}{8}$-in. round tie-rods in the sides and 1-in. square rods in the horizontal plane at each strut. Steel gusset-plates were used to make all splices. At the base of the tower a truss was used spanning the full width of the two barges, adding greatly to the rigidity of the hull. The derrick was a standard wooden derrick with 14x14-in. boom 60 ft. long, a 16x16-in. by 30 ft. mast, 12x12-in. stifflegs and a bull wheel for swinging. All lines were carried down to and operated from engines on the deck of the barges, one engine carrying boom and load lines, and a swinging engine.

Anchorages—Due to the proximity of the Ohio cable bent to the main highway it was necessary to deflect the cable through a sharp angle after passing the cable bent, so the wire construction was stopped at the cable bent and an eyebar chain of heat-treated bars was carried down from the cable bent to a structural steel anchorage embedded in a concrete beam under the hillside. In order to secure a symmetrical cable, the same construction was used at the West Virginia side, except that the eyebar chains were longer and terminated in a reinforced-concrete caisson anchored in bedrock. This construction permitted all anchorage work to be completed while the cable spinning and tower erection were under way and greatly facilitated the erection of the cable strands, since all the cable work was in the open.

Design Loads and Unit Stresses—The floor system was designed for a maximum load of a 15-ton truck at any point and for the maximum loading of two 40-ton street cars. Although the bridge was designed for the future addition of street car tracks, decision was made by the owners after construction was under way that no tracks would be added. The original design for the floor was based on using a flat slab about 11 in. thick with grooves left for the rails, but with the abandoning of the idea of using street cars an arch design was substituted in order to lighten the dead load. An impact allowance of $33\frac{1}{3}$ per cent was used in the design of all stringers and floorbeams.

For the design of stiffening trusses, cables, towers and anchorages, the assumed live load was 1,200 lb. per foot of bridge. The estimated dead load for the downstream cable was as follows: Cables and suspenders 176 lb., stringers 182 lb., floor beams 100 lb., trusses 375 lb., bracing 35 lb., concrete 1,380 lb., rails (not used) 82 lb. and sidewalk 160 lb., making a total of 2,490 lb. per foot of cable. On the upstream cable there was only 2,305 lb., the difference being due to lack of symmetry

caused by an overhung sidewalk on the downstream side.

The wind load was assumed as 30 lb. per square foot on 1½ times the vertical projection of the structure, with a temperature variation of ± 60 deg. F., all setting calculations being based on a normal temperature of 55 deg.

Cross-sections of members were calculated on a basis of 18,000 lb. per sq.in. except for the stiffening trusses, where 20,000 lb. per sq.in. tension and 18,000 — 60 l/r compression were used. Allowable compression in tower legs was assumed at 18,000 lb. per sq.in. — 70 l/r with a limiting value of 13,500 lb. per sq.in. The actual allowable stress used with an l/r ratio of 73.4 was 12,860 lb. per sq.in. The maximum cable stress is 2,881,000 lb. under full dead and live load combined with temperature stresses. The main cable consists of seven strands, each containing 280 No. 8 bright wires, making a total net area of 40.376 sq.in. and a miximum unit stress of 71,350 lb. per sq.in.

Spinning the Cable Strands—The West Virginia approach to the bridge consists of 1¼ miles of new road construction. The 1,800-ft. section adjacent to the bridge, being quite level, above high water and almost directly in line with the bridge, offered an excellent location for the spinning of cables on land; therefore this method was adopted. The experience with land spinning at Portsmouth dictated several changes in the methods of procedure—namely, the use of mechanically straightened wire, the use of a central splicing plant and the control of strand length by hydraulic jacks.

The wire specifications called for an elastic limit of 144,000 lb. per sq.in. and an ultimate strength of 215,000 lb. Tests of the wire showed values considerably higher than the specifications, and since mechanical straightening produced an average drop in the elastic limit and ultimate strength of only 2½ per cent, the wire was kept well above the specification requirements. The result of the straightening was that the wire laid quietly at all times without tendency to coil.

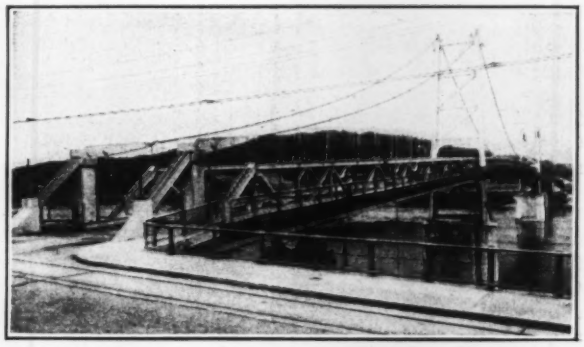


FIG. 4—COMPLETED BRIDGE, SHOWING JUNCTION OF CABLES AND EYEBARS AT OHIO CABLE BENT

The length of strands was about 1,300 ft. and the stress produced in a single wire hanging on a free span of 688 ft. 9 in. (the main span length) was approximately 60 lb. Since the ideal condition was to secure the same tension in spinning as the wires would later have while in course of adjustment, a tension of 60 lb. per wire was adopted, regardless of temperature changes. The land spinning method followed at Portsmouth used a basic tension per wire (such as 60 lb. at 50 deg. F. for No. 8

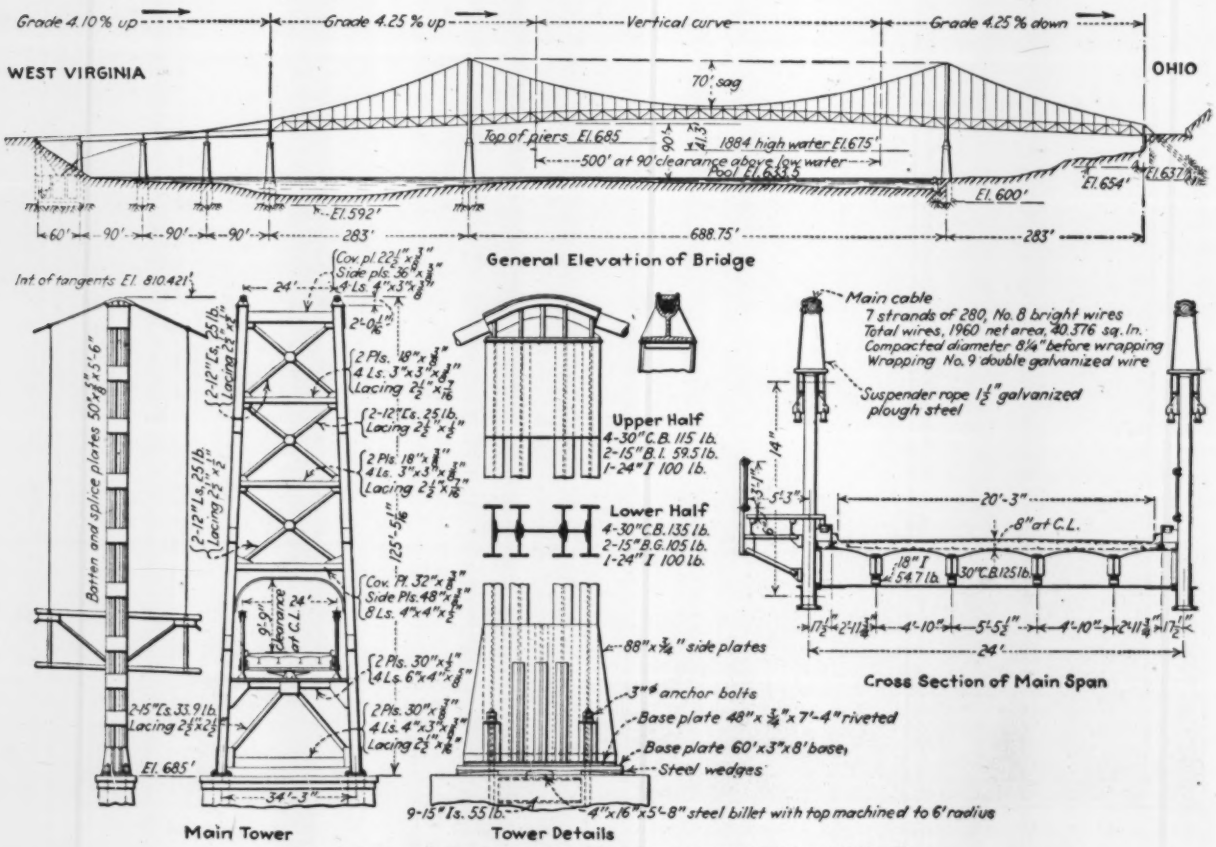
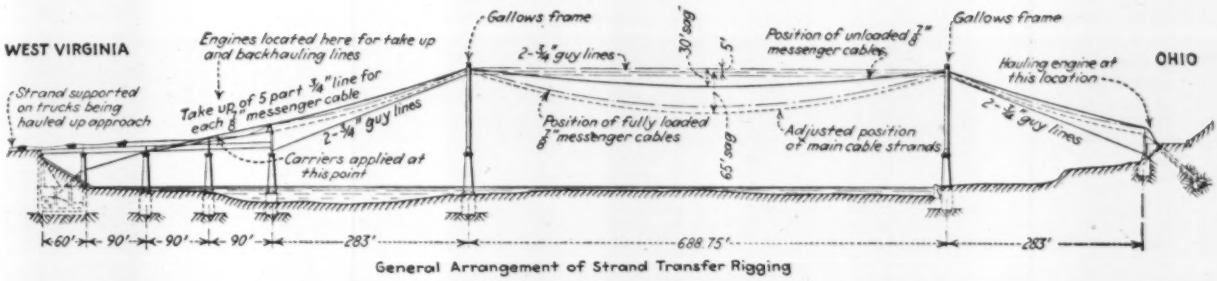
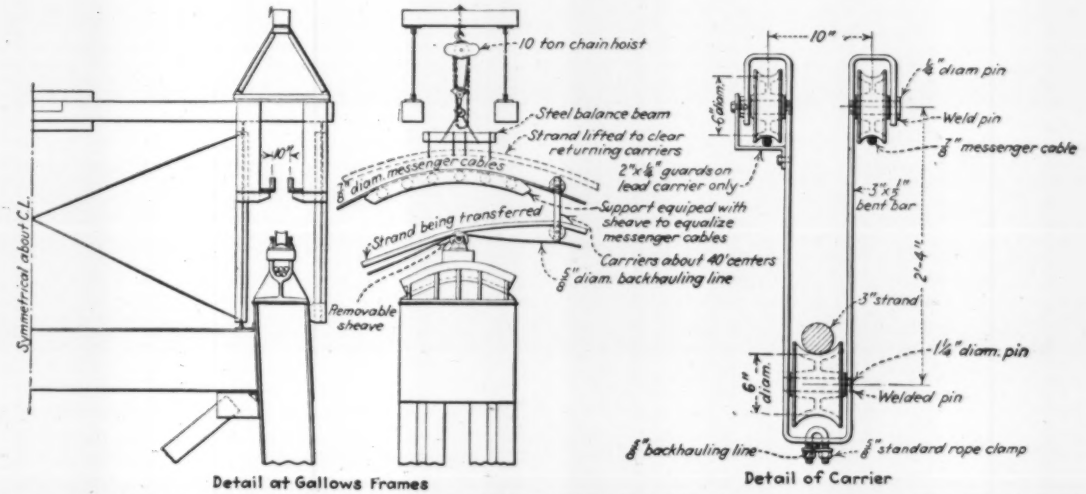


FIG. 3—DETAILS OF FORT STEUBEN SUSPENSION BRIDGE


WEST VIRGINIA
OHIO
Engines located here for take up and backhauling lines
Gallows frame
Gallows frame
2-¾" guy lines
30' sag
5'
Position of unloaded ⅞" messenger cables
Hauling engine at this location
Strand supported on trucks being hauled up approach
Take up of 5 part ¾" line for each ⅞" messenger cable
2-¾" guy lines
Carriers applied at this point
Position of fully loaded ⅞" messenger cables
65' sag
Adjusted position of main cable strands
2-¾" guy lines
60' 90' 90' 90' 283' 688.75' 283'

General Arrangement of Strand Transfer Rigging



Detail at Gallows Frames

Detail of Carrier

FIG. 5—ARRANGEMENT AND DETAILS OF RIGGING FOR TRANSFERRING CABLE STRANDS FROM SHORE INTO POSITION ON TOWERS

wire), and as the temperature changed the pull was varied at the rate of 4 lb. per degree of temperature change. This practice led to difficulties because at high temperatures work was interrupted due to the pull dropping below 20 lb., which was found to be the lowest practicable working pull, and at low temperatures the pull became too great. Another serious fault with the fixed-length method was that when the temperature dropped near zero, and particularly with strands almost finished, the temporary anchorages were subjected to a very large strain and had a tendency to pull together.

In order to permit spinning under a constant tension and to prevent the movement of the temporary anchorages, a hydraulic jack eqtipped with a calibrated gage was inserted between the strand shoe and the anchorage at one end only. The length of strand was then easily adjusted for temperature changes and the gage gave a direct reading showing the tension in the strand. When work ceased each night, the jacks were slacked off.

The spinning layout consisted of a standard-gage track about 1,400 ft. long with ties spaced about 5 ft. centers. Instead of using the customary continuous trough for land spinning, a V-shaped timber made of two 2x8 pieces was set up on the ends of each tie. This support was found to be quite sufficient and greatly facilitated the work of seizing the strand, since no removal of trough sections was necessary. All strands were spun from coils as delivered by the mill, the coils being about 40 in. in inside diameter and averaging about 350 lb. of wire to the coil. The ends of the coils were threaded by swaging and were equipped with ferrules for splicing, with the ferrules always on the rear end of the coil. Two parallel swifts were mounted at the end of the runway on each side of the track so that a spare coil would always be ready for splicing. The wire was hauled along the track by means of a car drawn by an endless cable operated from an engine located behind the swifts. Two roller-bearing swifts mounted on the car carried the bights of wire, so that one trip of the car laid two wires in each of two strands. The only stops in spinning were those necessitated by splicing, which took an average of two minutes for each splice. With this method of spinning as many as 110 wires were laid in each strand during a day. A standard two-drum hoisting engine with 24-in. drums was used for hauling the car.

Strand Transfer—The location of the bridge, only 625 ft. below Dam No. 10 in the Ohio River, dictated the use of an overhead system of strand transfer in order to eliminate interference with navigation. A study of previous methods of overhead transfer showed that all had used a single messenger cable with the strand carried on snatchblocks at about 50-ft. intervals. In general the method seemed satisfactory except that the removal and recovery of the snatchblocks offered some difficulty; particularly was this true at Steubenville, because the location was at times subject to a very swift current, depending on the position of the bear traps at the dam, which precluded the use of derrick boats without the risk of long delays due to river contlitions.

With the definite object of controlling all operations from land, a parallel messenger-cable system was finally adopted with carriers so designed as to permit their convenient return to the point of application. The arrangement of the strand transfer rigging is shown in Fig. 5. Temporary steel and timber gallows frames were erected at the tops of the main towers to act as supports for

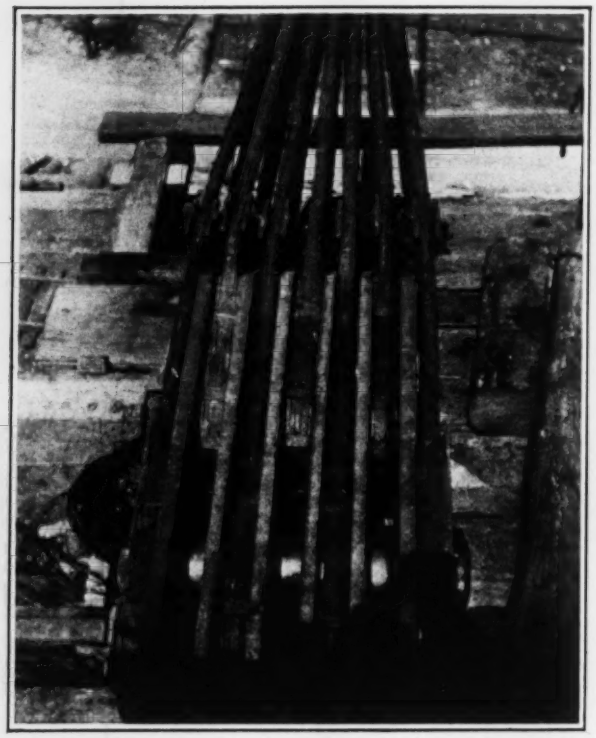


FIG. 6—CONNECTION OF WIRE CABLE TO EYEBARS
The shoes on the seven strands in the cable were placed on the river side of the cable bent. Two pins in steel yokes on the cable bent carried the strand shoes, three shoes attaching to the front pin and four to the rear pin as shown.

the messenger cables. In order to allow clearance of succeeding strands after the first strands were in position, the messenger cables were set about 5 ft. above the saddles at the main towers and 10 ft. above the pins at the tops of the cable bents. The $\frac{7}{8}$-in. messenger cables were carried down over the Ohio cable-bent tower and anchored to the eyebar back-stay, but on the West Virginia end they were carried back along the eyebar chains and equipped with separate take-ups consisting of a five-part $\frac{3}{4}$-in. line. The take-ups were inserted to adjust each messenger line independently in order to compensate for the variable stretch of the wire rope.

The gallows frames on the main towers carried a curved support consisting of two angles with 6-in. sheaves mounted to provide a support for the $\frac{7}{8}$-in. messenger cables, which would permit free movement of the messenger cable while the carriers rode over the curved support.

The carriers, shown in detail in Fig. 5, consisted of a two-roller carrier, with a third roller carried centrally on which the strand rested. The carriers were applied at the West Virginia approach about 90 ft. shoreward of the cable bent, the strands being hauled up the inclined approach to this point. Before starting across with a strand the $\frac{7}{8}$-in. messenger cables were adjusted as nearly equal as possible with about a 30-ft. main-span sag for the actual transfer. The $\frac{3}{4}$-in. hauling line was attached to the drum of a steam hoist located on the Ohio approach and was carried across the tops of the towers, resting in a temporary sheave on the main saddle and attached to the strand shoe of the strand being transferred. The back-hauling line was attached to the end of the hauling line by means of a loop around the strand shoe, and to this backhauling line the carriers were attached by means of a rope clamp. The two lines controlling the take-ups for the messenger cables were attached to the drums of a steam hoist located just riverward of the point of application of carriers, separate engines being used for the upstream and downstream systems; one of these engines was a three-drum hoist, the third drum carrying the backhauling line.

The transfer operation was started with the bottom strands of the upstream cable. As the strand was carried out the carriers were applied at about 40-ft. intervals. The messenger cables were kept sufficiently close to the same elevation with respect to each other without difficulty, and as the strands were carried across, the messenger cables were kept in constant adjustment to prevent interference of the strand being transferred with those already in position. As each strand was anchored at the two ends to the eyebar chains the strands were picked up by chain hoists on the gallows frames and raised about 5 ft. to allow returning carriers to clear the sheave on the main saddle.

Cable Attachment to Backstays—Since the eyebar backstays came up to the cable bent, it was necessary to place the strand shoes on the river side of the cable bent. The seven shoes were arranged in tandem formation, so that they were placed on two pins in steel yokes attached to the top of the cable bent. Three strands were attached to the front pin and four to the rear, so arranged as to prevent any crossing over of strands and to eliminate any difficulty of erection. All strand shoes had provision for an adjustment of $4\frac{1}{2}$ in. Since it was found convenient to do all adjusting on the West Virginia side and since the methods of spinning indicated that the strands would be nearly correct in length, all strand shoes were set on center at the Ohio cable bent and the adjustments of length were made at the opposite end. The correctness of the spinning was verified by the fact that the maximum adjustment needed was 3 in. and that some strands were within less than 1 in. of the correct length.

Strand Adjustment by Leveling—In order to eliminate the delays caused by field computations in adjusting cable strands, levels were used exclusively on this work.

FIG. 7—EYEBAR CHAIN FROM CABLE BENT TO ANCHORAGE, WEST VIRGINIA APPROACH

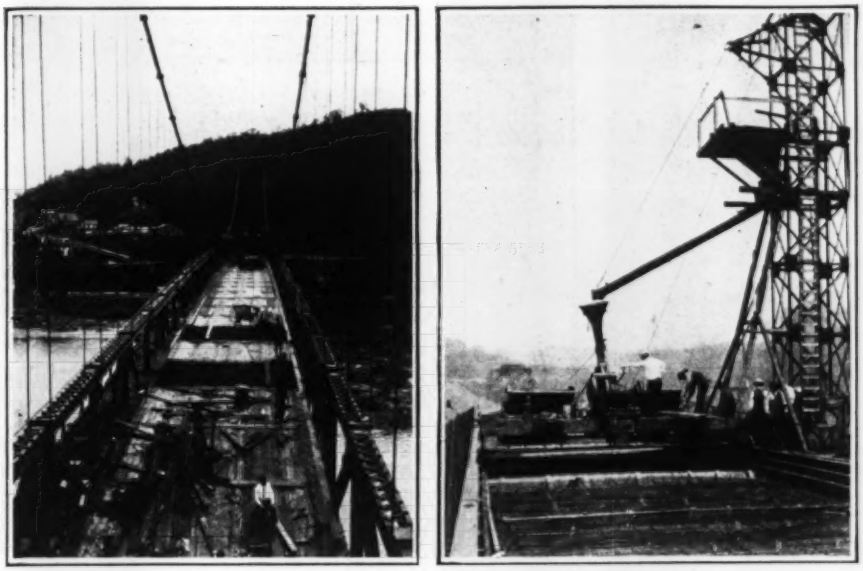


FIG. 8—FLOOR CONSTRUCTION ON THE STEUBENVILLE BRIDGE
At the left is shown a general view of the floor forms. At the right concrete is being poured from the tower to a buggy running on the roadway curb.

Hanging targets were placed at the center of the main and side spans, with the zero point of the scale on the center of the strand. With levels located on the top of the portal struts of the main towers, readings were taken on these targets, and from previously tabulated data the necessary adjustments were made at once. This method was so successful that all four bottom strands were adjusted in less than two working days.

Stiffening Trusses—The stresses in the stiffening trusses were computed by considering the truss and cable as a redundant system. This method assumes that the cable retains a parabolic form under live loads and neglects certain deflections of the cable under such loads. Stresses secured by this method are in general slightly larger than the actual and are thus on the safe side. The trusses are continuous over three spans, and while they are attached at the main towers and at the cable bents to prevent vertical movement, all these joints are supplied with sliding joints to permit free horizontal movement.

The chords of the stiffening trusses are two 15-in. channels varying from 33.9 to 55 lb. per foot, with flanges turned out and top and bottom single laced. Where additional material was necessary, web plates were added. Full advantage was taken of I-beam construction, and all verticals and diagonals were made of 10-in. Carnegie beam sections. The resultant saving in shop work can best be shown by comparison with the Portsmouth bridge, which averaged 97 shop rivets per ton of steel, whereas the Steubenville bridge averaged 68; or, if expressed as a percentage, the shop riveting of the newer design is but 70 per cent of that of the former structure. The same percentage is true of the field riveting, this being due largely to the use of symmetrical chord sections in the stiffening trusses, which eliminated eccentric splices and thus reduced the number of rivets. Although the comparison of rivets is not the only consideration, it does indicate a considerable reduction of labor; and the use of beams in place of built-up members reduced the number of parts to be handled by a much greater percentage than the reduction in rivets. The I-beam construction offers surfaces easily accessible for painting and, combined with greater thicknesses of material, will decrease greatly the maintenance of the structure.

All stiffening trusses were fabricated in two panel lengths and weighed from 7 to 9 tons each. The Ohio side span was entirely over land, so erection progressed from the shore end, using a 10-ton jinniwink. The main span and West Virginia side span, being entirely over water, were erected with a standard derrick boat equipped with a special 130-ft. boom. The main-span steel was started at the center of the span and progressed both ways toward shore, while the West Virginia side span was erected from shore toward the main span. As all trusses had been shop-assembled and reamed, the fitters-up followed closely after the hoisting crews and pinned up all joints without difficulty. No riveting was done until all steel was in place, after which all floor steel was riveted as well as the bottom-chord joints of the stiffening trusses except at the main towers. Riveting was then stopped until all concrete was in place on the floor, after which the top-chord joints and the remaining bottom-chord joints were riveted.

Concrete Floor—The unusual type of floor design resulted from the decision to abandon provision for future addition of car tracks. It is an arched floor, but it was designed as a flat slab, the only effect of the arch being to lighten the bridge. In order to permit the proper distribution of loading, a steel curb was used which served as a track on which was run a concrete transfer car carrying two 1-yd. buckets, propelled by a gasoline engine-driven winch mounted on the car and attached to a fixed cable running from end to end of the bridge. All concrete was mixed at a plant on the West Virginia bank and delivered to the car by a hoisting tower. The method of placing concrete from a cable-operated buggy, also the position of the concrete tower, is shown in the right-hand cut in Fig. 8.

Cable Wrapping—The cable was squeezed down to about 8¼ in. diameter before wrapping. The wrapping, done immediately after the placing of the concrete floor, consisted of No. 9 double-galvanized steel wire applied under tension by a motor-driven wrapping machine. The work of squeezing and wrapping was done from cages suspended from trolleys running on the main cables and operated by means of lines from hoists located on the approaches.

Administration—The entire bridge was designed, constructed and erected by The Dravo Contracting Company, Pittsburgh, Pa. Clarence W. Hudson of New York acted as consulting engineer for the Steubenville-Weirton Bridge Company, the owner. The cable squeezing and wrapping equipment used was that developed and patented by H. D. Robinson, of the firm of Robinson & Steinman, New York.

Floating a 300-Ft. Bridge Span Into Position

Span Built on Falsework Near River Bank Is Transferred to Barges and Moved to Piers by Steamers

By J. F. Jackson
Consulting Engineer, Milwaukee, Wis.

FLOOD conditions in the Atchafalaya River in the spring of 1928 necessitated special methods in placing the last span of a combined railway and highway bridge built for the Louisiana Railway & Navigation Company at Simmesport, La.

This bridge is 1,200 ft. long, consisting of two 150-ft. spans, two 300-ft. spans and a 300-ft. swing span. All except one of the 300-ft. fixed spans had been erected before the season of high water, which came in December, 1927, and would last until the following August or September. The depth of water under this span is about 85 ft., with stage of the river 32 ft. above low water. The swift current (about 7 m.p.h.), with silt bottom and great depth of water, made it impossible to construct ordinary falsework in the river. It was therefore determined to float the last span into position. This operation is shown in Fig. 1.

Ordinary pile falsework, parallel with the river and having one bent under each panel point, was constructed on the downstream side of the bridge below the first river pier, about 100 ft. from the west bank, as shown in Fig. 2. The water at this point was not deep, and the pier protected the falsework from driftwood, which was brought down in considerable amount by the swift current. Steel was delivered direct to the falsework from the track on the bridge at this pier. After the steel was raised and riveted, two bents of falsework on each side of the center were removed to provide room to float two large railroad barges or car-transfer boats into position under the span. These barges, used for ferrying cars down the Red River 10 miles and across the Mississippi to the east bank, were each 37 ft. in width. One was 250 ft. and the other 295 ft. long, both stiffened by high longitudinal steel trusses.

Footings for falsework about 32 ft. high were spread on the decks of the barges by means of bridge timbers,

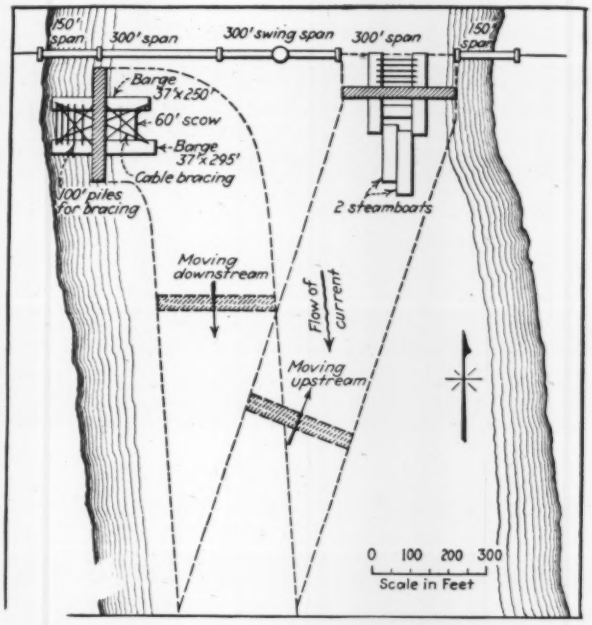


FIG. 2—METHOD OF HANDLING FLOATING SPAN

so as to distribute the load on the length of the barges as much as possible. The weight of span was 560 tons, and the falsework weighed about 200 tons. Some extra water ballast was put in the end compartments of the barges to help balance the heavy center load. This falsework was heavily braced, both laterally and longitudinally, and the central part of the pile falsework was removed so that struts and braces of 100-ft. piles could be placed between the barges to prevent any torsion on the falsework system while the bridge was being towed to position. A 60-ft. scow was also placed between the barges for bracing, as shown, and cables were placed diagonally to tie the structure together.

Preliminary work being finished by March 28, 1928, sufficient water was pumped out of barges to give buoyancy enough to lift the span from the falsework. Then the barges carrying the span were moved out toward the center of river and turned 90 deg., being controlled by long lines from the completed spans. Two large stern-wheel steamers were hitched side by side to the down-

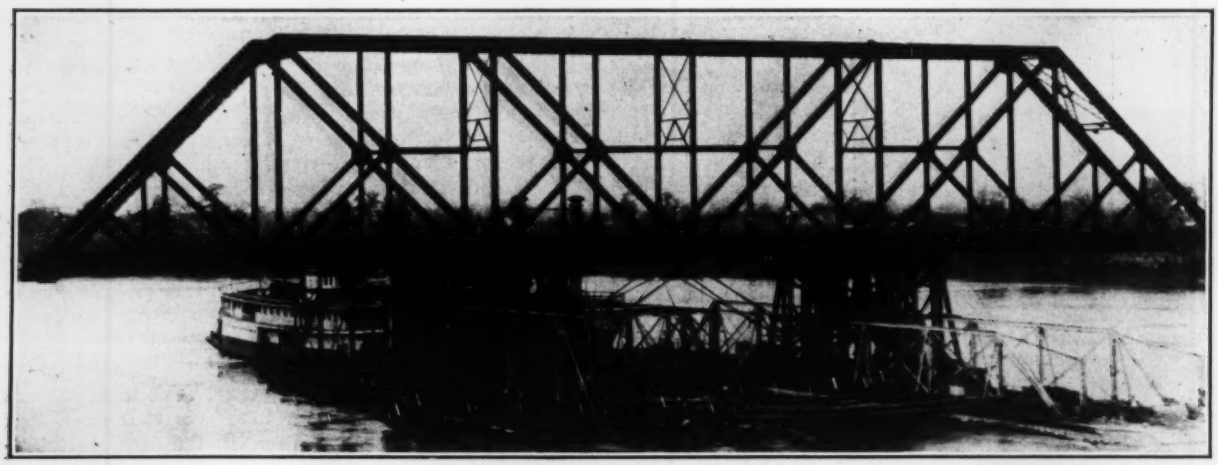


FIG. 1—BRIDGE SPAN BEING FLOATED INTO PLACE

stream end of the floating system, after which the lines were cast off and the whole assembly of steamers, barges and bridge dropped downstream diagonally about ¼ mile under control of the two steamers. Then the steamboats were speeded up and the span brought upstream slowly to position over piers, where by means of water ballasting the barges it was quickly lowered to position on bridge shoes which had been set in advance. The work of floating the span, moving it out and around, hitching steamboats, etc., required several hours, but the actual floating downstream and up again to a landing on the bridge piers required only half an hour. An interested spectator of the proceeding was the president of the railroad, Mrs. Sarah Edenborn.

The Wisconsin Bridge & Iron Company, Milwaukee, Wis., had the contract for this bridge, and D. K. Allinder, superintendent of erection, was in charge of the work. This writer, formerly vice-president of the company, suggested the general scheme of operations.

Arch Dam of Unusual Design

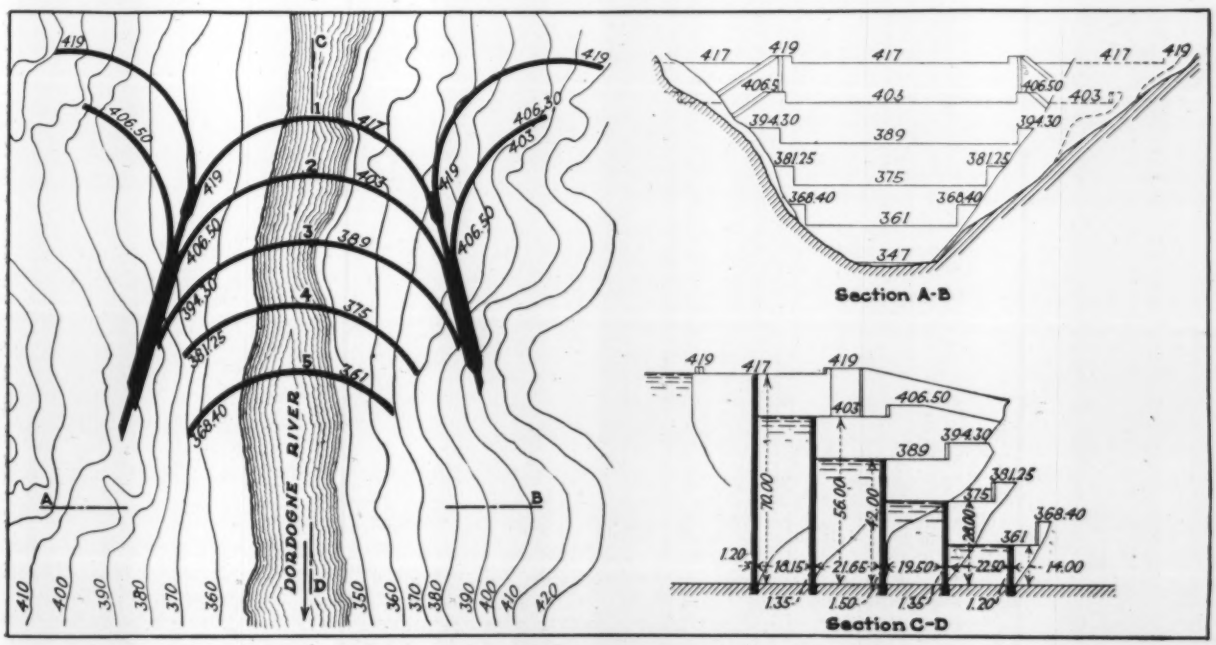
Many Advantages Are Claimed for This New Type of Structure—Test Models Show Ample Factor of Safety

A NOVEL type of arch dam, for which several important advantages are claimed, has been developed by two Frenchmen, MM. Mesnager and Veyrier. The merits of the new design have appeared sufficient to justify the granting of a government subsidy of 200.-000 francs to the inventors for further experimentation. Although no structure of this type has yet been erected, plans have been prepared for a dam on the Upper Dordogne River, and extensive tests have been made upon models at the laboratory of l'Ecole des Ponts et Chausées.

The principle used is that, since the cost of a dam increases rapidly with the height, it is cheaper to build a series of low dams than one high one. As seen by the plan, the first arch is built to the full height desired, but is of unusually light construction. Immediately below this is a second light arch, of lesser height, below this a third, still lower, and so on for as many steps as are necessary. The light construction is made possible by the intermediate pools, which provide a balanced load on the lower downstream section of each arch and which materially lower the effective water pressure against each dam. Not only does this reduce the amount of material in the structure but it also prevents scour below the dam at times of overflow. Floodwaters passed by the crest will descend in a series of short drops rather than in one sheer fall. This feature eliminates the necessity for the diversion canals or tunnels which are often necessary to protect the foundations. Still another advantage is that after construction is completed the new type dam can be thoroughly tested by subjecting it to double, triple or even greater multiples of the usual working pressure, simply by emptying one or more of the intermediate pools. This test can be repeated at any time fears for the safety of the dam are expressed. Failure of any wall would not be followed by complete loss of the structure, but would simply double the pressure on the adjacent wall.

The tests at the Ecole des Ponts et Chaussées were made on plaster models of the contemplated dam on the Upper Dordogne reduced to a scale of 1:100. Mercury was used in place of water. As this has 13.6 times the density of water and the plaster used had a strength of 1 : 7.3 as regards concrete, it was considered that the tests on these models (1 : 100 scale) would be comparable to actual results on the contemplated structure. By repeated tests under unbalanced conditions secured by emptying one or more pockets it was found that the factor of safety of the design was between four and five.

The tests were made possible by a subsidy of 200.-000 francs granted by the French Minister of Public Works. The Department of War loaned a 15-ton stock of mercury valued at 1,250,000 francs to the experimenters for the duration of the tests.



PLAN AND SECTIONS OF PROPOSED DAM IN FRANCE
Increased safety and lower cost claimed for design involving a series of light arches.

New Freight Terminal at Houston, Tex., for M-K-T Lines

Enlarged Facilities on New Site to Provide for Increasing Traffic Include Freight Station, Transfer Platform, Team Yard and Platform for Loading and Unloading Automobiles—Future Extensions

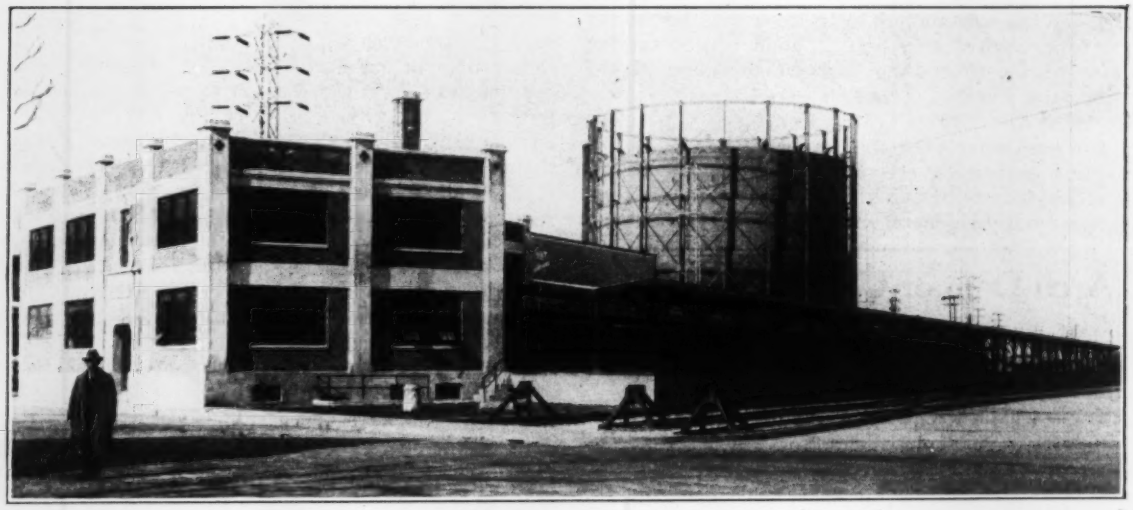


FIG. 1—HOUSTON FREIGHT STATION; M-K-T LINES
Two-story building for offices. Freight house in background. Transfer platform and team-yard driveway at right.

A NEW freight terminal established by the Missouri-Kansas-Texas Lines at Houston, Tex., to provide improved facilities for increasing traffic at that point includes a freight station (with offices for the freight department), transfer platform, team yard and platforms for loading and unloading automobiles. Fig. 1 shows the two-story office building, with transfer platform, tracks and one of the team driveways at the right. At present the freight house serves for both inbound and outbound business, but provision is made for a separate outbound house when traffic requires it. This latter building will displace three of the present team tracks, one of them becoming a house track, but three new team tracks with driveways may then be built in the present unoccupied space west of the automobile platform. The present layout and future enlargement are shown in Figs. 2 and 3. In the design of the building and the general plan particular attention was given to insure effective utilization of the area, convenient operation and low maintenance cost.

In the handling of its freight business at Houston the railroad has been hampered by the cramped conditions at its former location, where street approaches were restricted and where expansion could be made only at prohibitive expense. To improve this situation, property for a new site, several blocks distant, was acquired in an old residential district which is being invaded by industrial developments. Here the freight station fronts on Gable St., which has been widened to 80 ft. by the city and paved with brick. Of this width, 30 ft. is railroad property and forms a driveway, thus providing ample space for handling teams and motor trucks at the freight house without interfering with street traffic. Other streets in the neighborhood have been improved and paved with bricks to facilitate traffic movements.

Freight Station—This building, with 600 ft. frontage on Gable St., is 50 ft. wide and has an 8-ft. platform along the rear, serving the house tracks. An open platform 100x58 ft. at the north end of the building may be extended about 100 ft. A ramp with an inclination 1½ in. to the foot, from the freight house driveway, enables tracks to be run up on the platform. The south end of the building, fronting 80 ft. on Gable St. and 80 ft. on Magnolia St., is a two-story structure. On the first floor are the freight house foreman's office, a room in which the officials may hold conferences with employees, locker and toilet rooms for the freight handlers and a locked room for holding valuable or damaged freight, held awaiting disposition. On the upper floor are the freight department offices and record room.

The building is of reinforced-concrete construction, with 11-ft. clear headroom. It has three rows of columns spaced 20 ft. c. to c. longitudinally and supporting longitudinal girders between which are the transverse beams carrying the flat roof slab, upon which is laid a bituminous roofing. Expansion joints are provided at every third panel, or 60 ft. apart, extending entirely across the building and platform. Plates of stainless steel are used for the bearings of the concrete girders at these joints, and in each vertical joint are placed two sheets of thin galvanized metal. Brick firewalls, having openings fitted with automatic fire doors, divide the freight house into three sections.

There are practically no side walls, the spaces between columns forming doorways 8 ft. wide and 9 ft. in clear height, fitted with rolling steel curtain doors. There is no skylight or monitor, but ample interior light is provided, even with all doors closed, by a continuous row of shallow windows above the doorways. This will be seen from Fig. 4. Although the site is near Buffalo

Bayou, a good foundation for the footings was found about 6 ft. below grade.

For the most effective use of trackage on property of such high value it was important to avoid the spotting of cars at doorways as far as possible. This was the main reason for making the doorways practically continuous, as noted, so that with the further assistance of the outside trucking platform there is no necessity of cutting or uncoupling cars in order to spot them opposite doorways. For the same reason, the transfer platform has its roof supported by one central row of posts instead of by posts along each side.

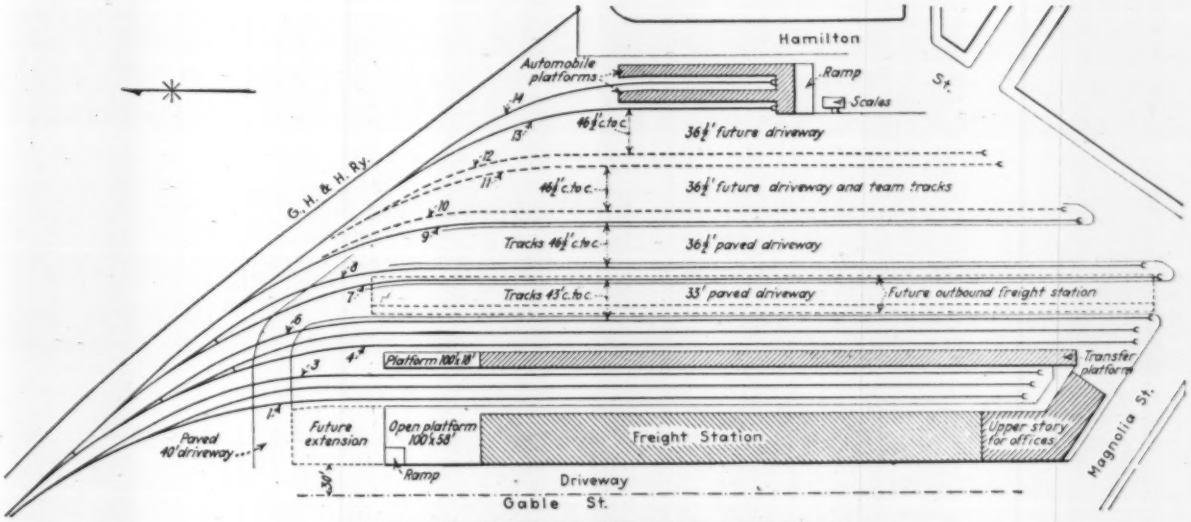


FIG. 2—NEW FREIGHT TERMINAL AND EXTENSIONS

The two-story structure has a frame of reinforced concrete, with red brick curtain walls and white trim of precast concrete. The office, toilet rooms and conference room in the first story have floors of concrete, with hardened finish; on the second floor the concrete slab is covered with linoleum in the offices and with red tile in the toilet rooms. The stairs are of concrete, with tile landings and glazed-brick walls. To insure good fire protection, no wood is used in structural work and very little for trim. Steel sash is used throughout, with metal screens and venetian blinds, while all interior doors are metal covered. Office furniture, counters, desks, chairs and record shelving are all of steel. For the steam-heating system there is an oil-burning boiler, fuel oil being stored in a large tank buried outside the basement and cased with concrete.

The future outbound freight house will be 800x30 ft., with an 8-ft. platform on the track side and a 51-ft. brick driveway at the rear. There will then be three tracks between each freight house and the transfer platform.

Platforms and Floors—On the track side of the freight house is an 8-ft. trucking platform, covered by a steel frame canopy with asbestos roofing. A similar canopy extends along the driveway side, so that freight is protected from the weather while being handled to and from cars and trucks. The trucking platform extends along the rear of the Magnolia St. wing, where it is 15 ft. wide, and connects with the transfer platform, 16x722 ft., so that tractors and trailers can travel between the freight house and transfer platform. Except for 100 ft. at the north end the transfer platform has a steel-frame canopy or butterfly roof.

For the freight house floor, a concrete slab laid on a solid fill is covered with asphaltic mastic. The slab is extended to form the outside platform, where its surface (before setting) was treated with a chemical hardener and given a float finish. The fill for this floor and platform is of adobe earth taken from the site and placed between the concrete walls by dump wagons. As this material cannot be compacted properly without being wetted, it was rolled in 12-in. layers with a 10-ton roller, the completed fill being then saturated with water, and the surface leveled to grade and finished by hand. A similar fill was made for the transfer platform, which also has a concrete slab with hardener applied during the finish floating.

Creosoted timber construction with plank flooring is used for the automobile platforms, which are 164 ft. long, 12 ft. wide and 15 ft. apart. They extend from a platform across the ends of the two tracks and are approached by a ramp of about 1 in 6, so that both the side-door and end-door cars can be loaded and unloaded. A paved space at the side of the street makes a convenient approach and has a 10-ton scale for weighing automobiles.

Team Yard—The four team tracks, each about 1,000 ft. long and accommodating about 75 cars in all, are arranged with one pair 12 ft. c. to c. between two driveways and a single track outside of each driveway. Teams can enter from the south at Hamilton Ave. and pass out over a 40-ft. concrete driveway into Gable St. on the west. To provide for the future enlargement, already

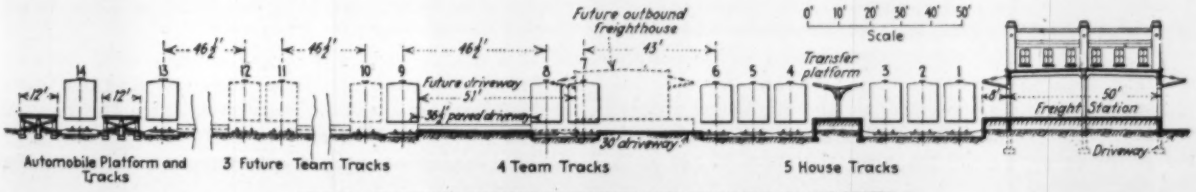


FIG. 3—SECTION SHOWS PRESENT AND FUTURE FACILITIES

FIG. 4—INTERIOR OF REINFORCED-CONCRETE FREIGHT HOUSE
Note floor light from windows with all doorways closed.

mentioned, the first driveway is 33 ft. wide and is paved with brick on the graded earth surface. The other driveway is 36½ ft. wide and is paved with concrete. Track crossings are paved with asphalt-macadam.

Track Layout—In the present arrangement there are two house tracks at the freight house, a track for cars to be unloaded at one side of the transfer platform and two tracks for cars to be loaded on the opposite side. Thus freight has to be trucked only through one row of cars in each case. All these tracks are spaced 12 ft. c. to c., with center lines 7½ ft. from the edges of adjacent platforms. About 94 cars can be placed on these five tracks. The future arrangement of tracks when the new outbound station is built has been noted already. All tracks are laid with 85-lb. rails on creosoted ties in shell ballast. The curves range from 10 to 16½ deg. The turnouts have 15-ft. switch rails and No. 8 frogs. All are stub tracks with steel bumping posts.

Engineers and Contractors—The general layout and all construction plans were developed in the engineering department of the Missouri-Kansas-Texas Lines, and the project was carried out under the direction of F. Ringer, chief engineer; A. B. Underwood, assistant engineer, was in direct charge of the work. The building was designed and its construction supervised by A. L. Sparks, architect for the railroad. The general contractor for the freight station and other structures was T. H. Johnson, of Sedalia, Mo. All track work was done by railroad forces.

More Crossing Eliminations Planned in New York

The New York State Public Service Commission has added to the 1928 program of 203 grade-crossing eliminations announced last December a supplementary list of 23 additional projects to cost $2,022,500. These are located in Essex, Chenango, Genesee, Sullivan, Jefferson, St. Lawrence, Nassau, Lewis, Schenectady, Monroe, Ontario, Putnam, Dutchess, Steuben, Herkimer and Westchester counties. In the near future hearings will be held, plans considered and determinations as to type of crossings made. Most of the crossings on the supplementary list require immediate attention, because improvements are contemplated to the highways in the vicinity. The usual division of costs will be followed, the railroads paying 50 per cent, the state 40 per cent and the counties 10 per cent.

Wood Preservation in 1927 Shows High Records

PRESERVATIVE treatment of timber during 1927 made an important increase over the previous year, which in turn had shown advances over 1926, according to the annual statistics prepared by R. K. Helphenstine, Jr., for the U. S. Forest Service, in co-operation with the American Wood Preservers Association. To summarize, there were 187 treating plants in operation (as against 180 in 1926 and 167 in 1925); 10 new plants were constructed (as against 14 in 1926). Of the 187 plants, 117 were of the pressure or closed cylinder type, 56 were non-pressure or open-tank plants and 14 were equipped for both methods. The quantity of wood treated was 345,685,804 cu.ft., or 56,363,725 cu.ft. more than in 1926. In classes of material treated, the greatest increase was in railway ties; then in order came poles, miscellaneous material, wood blocks and construction timbers.

The amount of creosote used, 219,778,430 gal., was the largest annual quantity ever reported. Of petroleum, 22,911,134 gal. was used, all of it for diluting creosote and the mixture being used mainly for treating railway ties. On the other hand, the 22,162,718 lb. of solid zinc chloride was a decrease from 1926, following decreases in the two previous years. Of the creosote, nearly 60 per cent was of domestic production. Paving oil for treating wood blocks amounted to 1,389,465 gal., or little more than half the amount used in 1926. In addition to the ordinary preservatives listed, the treating plants consumed 631,234 gal. of miscellaneous preservatives.

Railway ties treated numbered 74,231,840, the largest number ever reported; they represented, as usual, about 64 per cent of all the wood treated. Of these ties, 43,813,897 (or 59 per cent) were treated with creosote, 15,791,147 (or 21 per cent) with a mixture of creosote and petroleum, 10,879,800 with zinc chloride, 3,716,996 with zinc-creosote emulsion and about 30,000 with miscellaneous preservatives. All were treated under pressure, with the exception of 27,425 ties given an open-tank treatment. Piles represented 17,241,345 lin.-ft., and 77 per cent of these were Southern pine, Douglas fir ranking second with 16 per cent. Nearly all were treated with creosote, though creosote-petroleum and zinc-creosote mixtures were used for small quantities.

Wood blocks for paving aggregated 2,008,160 sq.yd., of which only 468,847 sq.yd. was for outdoor paving. Of these blocks 84 per cent were Southern pine and the remainder Douglas fir, while paving oil was used more extensively than creosote for the preservative. Construction timbers treated aggregated 182,411,211 b.ft., of which switch ties represented 46 per cent and bridge timbers 30 per cent. Treated poles numbered 3,637,989, nearly half being of Southern pine; this number also was an increase over 1926.

Railroad Carries Automobiles Through Floods

During the recent floods in the Southwest the Rock Island Railroad came to the rescue of motorists by establishing a shuttle service between Brinkley and DeVall's Bluff, Ark. A train of ten flat cars was operated during daylight hours without interfering with the regular railroad schedules. During the first week of operation 1,360 automobiles and 2,623 passengers took advantage of the service.

Tall Reinforced-Concrete Building Involves Special Design

Unsymmetrical Column Layout—Height Requires Special Wind Bracing—Comparison With Steel Framing

By Benjamin B. Shapiro
Consulting Engineer, Chicago

A REINFORCED-CONCRETE building recently built in Chicago is notable for its height and structural design and also for having been designed originally for steel framing. This is the Whitehall Apartment Home, 105 East Delaware Place, shown in Fig. 1. It is 21 stories high, with two additional stories in the pent-house, and is of reinforced concrete throughout, except for two steel beams in the eighteenth floor to carry offset columns above. In plan the building is irregular, as shown in Fig. 2, with a frontage of 99 ft. 10 in. on East Delaware Place and 74 ft. 3½ in. on Ernst Court. It is founded on 60-ft. wood piles driven to refusal and cut off at 1 ft. below city datum. In this section of the city it is not desirable to sink wells for concrete piers, on account of the gases emitted by groundwater encountered before arriving at bedrock. The piles, grouped under the column footings, are figured to have a carrying capacity of 25 tons each. Because of the irregular shape of the building, there are seven combined footings, each carrying two columns.

The story height is 13 ft. 9 in. in the first story and then 9 ft. 10 in., except that the 21st story is 15 ft. 1½ in. from floor to finished roof slab, to take care of mechanical offsets. From sidewalk to pent-house roof the total height is 234 ft. 9⅞ in.

Framing Design — Because of the unusual irregularity in plan, the column spacings varied, and columns were arranged to secure the minimum obstruction by being included in partitions, closets and pipe shafts. The largest column is 23x42 in. in the basement and 21x37 in. in the first story. Floor construction consists of 8-in. joists, 5 in. wide and 35½ in. c. to c., with a 2½-in. slab. For some of the longer spans the joists are 10 in. deep. The slabs are reinforced for temperature changes by 4x12-in. rectangular welded mesh. A ¾-in. cement finish was applied to all structural concrete slabs. Floors are designed for a 40-lb. live load, plus partition and other loads as required by the Chicago building code. The roof framing is similar to that of the floors, except that under the pent house there are 7½-in. solid slabs to carry the loads of the ventilating fan and service tank rooms, and 8-in. solid slabs to carry the operating machinery for the elevators.

FIG. 1—WHITEHALL APARTMENTS, CHICAGO
Reinforced-concrete building, 21 stories, 234 ft. 10 in. in height.

Reinforced-concrete curtain walls of 1:1:2 mix, 12 in. thick, built monolithically with the first-floor spandrels, inclose the basement, in which are housed the heating, refrigerating and water-treatment plants, a coal bunker and service storage space for the apartments. The building is faced with limestone or marble up to the fourth floor, and with dark red brick above. Hollow clay tile forms the backing for walls. Partitions are a gypsum tile, usually with two layers in the walls which separate apartments, insulation being placed between the layers. Electric conduits and plumbing pipes are embedded in the floor slabs or carried on hangers between the joists. Ceilings of plaster on metal lath are placed immediately below the concrete joists or suspended and carried by means of furring channels dropped to the required depth below the joists.

Special Structural Features—As the building is tall and slender, ranking second in height among Chicago's reinforced-concrete buildings, it presented an unusual windbracing problem. Its irregularity in plan offered further complications in the design to provide against wind stresses. Interior beams had to be kept as small as possible, and while the spandrels were limited to a width of 8 in., they could not be very deep. Consequently the spandrels at the third floor along the Delaware Place elevation extend both above and below the floor slab.

With an assumed wind load of 20 lb. per square foot, the wind stresses were computed and then combined with the stresses produced by the dead and live loads. Connections of the beams to the columns were designed to take not only the moment due to wind load but also the negative moment due to dead and live loads. Fig. 3 shows a partial windbracing diagram, giving the location of the steel bars used to take care of wind stresses, in addition to the reinforcement required to provide for the stresses occasioned by the combined dead and live loads.

In many of the spandrels, particularly at the second floor, the moments due to wind were considerably higher than those resulting from the combined dead and live

loads. To provide for this factor, the bent bars in the spandrels were omitted, and straight bars were used in the tops and bottoms of the beams. In continuous spans these bars were extended 3 ft. beyond the center lines of the columns and were hooked into the end columns with a rectangular hook. In panels 1 to 6, 12 to 18, 20 to 29, 27 to 35 and 37 to 39 (see Fig. 2) the spandrels from the third to the tenth floor, inclusive, had the usual straight and bent reinforcing bars. In addition, they were designed with short top and bottom bars having rectangular hooks at the end columns and 6-ft. top and bottom bars at all the columns between the end columns.

In panels 8 to 12, 18 to 20, 29 to 27, 35 to 37 and 39 to 1, the spandrels from the third to the fifteenth floor, inclusive, were likewise reinforced to take care of the wind stresses. This was done also in a number of the first-floor beams. In the second floor, beams between columns 35, 36 and 37 were similarly reinforced. Stirrups were used in all spandrel beams where shear requirements called for them. Concrete of a 1:1:2 mix (3,000-lb.) was used for all the columns up to the ninth floor; above that, a 1:2:4 mix (2,000-lb.) for both slabs and columns.

Rapid Construction—Although the work was done during the winter, rapid progress was made in erection as shown by the accompanying schedule and described in *Engineering News-Record* of June 7, p. 900. The first piles were driven in November, 1927, and the driving continued for four weeks. The first concrete was placed in the footings on Nov. 21 and in the columns on Dec. 2. It was ordinary speed to place two floors per week, and a speed of three floors per week was attained on three occasions, in spite of the fact that precautions had to be observed to prevent freezing of the concrete during placement and curing.

CONSTRUCTION SCHEDULE: WHITEHALL APARTMENTS, 1928

Floor	Date of Placing	Floor	Date of Placing
First	Jan. 5	Twelfth	Feb. 22
Second	Jan. 14	Thirteenth	Feb. 27
Third	Jan. 20	Fourteenth	Feb. 29
Fourth	Jan. 23	Fifteenth	March 2
Fifth	Feb. 1	Sixteenth	March 6
Sixth	Feb. 3	Seventeenth	March 8
Seventh	Feb. 7	Eighteenth	March 12
Eighth	Feb. 9	Nineteenth	March 15
Ninth	Feb. 11	Twentieth	March 17
Tenth	Feb. 15	Twenty-first	March 20
Eleventh	Feb. 17	Roof slab	March 23

Quality Control of Concrete—The contractor's regular practice of governing the strength of the concrete by the water-cement ratio specification was followed, under the inspection of the Robert W. Hunt Company. Tests of control cylinders were made at 7, 14 and 28 days, the 14-day tests being principally to assist the contractor in determining the earliest date at which formwork might be removed. For the 1:1:2 mix (3,000-lb. strength), the control cylinders averaged 2,440 lb. in 7 days and 4,000 lb. in 28 days. For the 1:2:4 mix (2,000-lb.), the averages were 1,500, 1,655 and 3,020 lb. for 7, 14 and 28 days, respectively.

Economy in Concrete Framing—An important feature in connection with this structure is the large saving in cost effected by the use of a reinforced-concrete frame instead of structural steel. Original plans were drawn for the latter, with an identical column layout, but bids by several firms showed that the cost would be more than the owner desired to invest. On a redesign in reinforced concrete, bids from the same contractors were

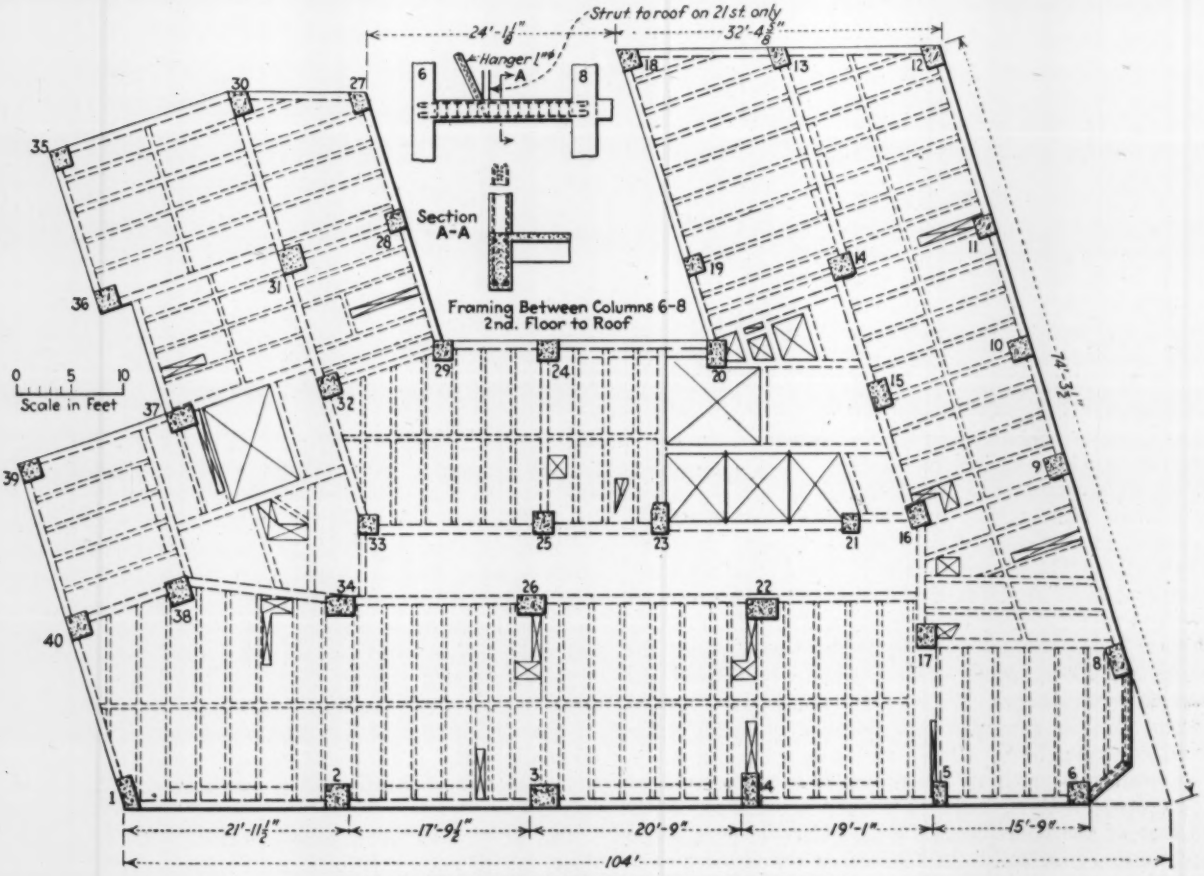


FIG. 2—FRAMING PLAN OF CONCRETE BUILDING

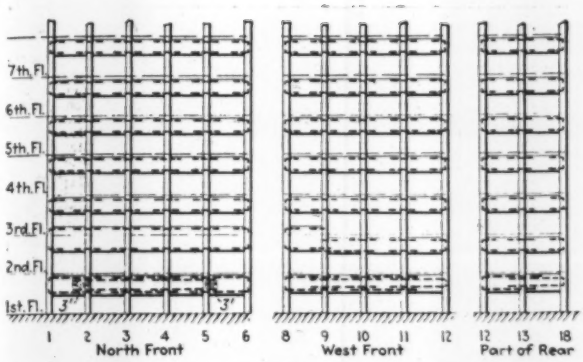


FIG. 3—WIND BRACING IN TALL CONCRETE BUILDING

much lower, with three bids very closely in accord. On the structural frame alone, reinforced concrete showed a saving of $70,000. Other savings, including the substitution of wood piles for concrete piers, showed an additional saving of $30,000. The reinforcing steel amounted to 456 tons. In the original design the structural steel amounted to 509 tons and the reinforcing steel to 95 tons.

Designers and Builders—The architects were Eugene H. Klaber and Ernest A. Grunsfeld, Jr., with Lowenberg & Lowenberg as associate architects. The Adolph Lindstrom Company had the general contract. The writer was structural engineer.

Change of Water Rights Doctrine in State of Washington

UNTIL about ten years ago the Supreme Court of the State of Washington followed English and Eastern American common law on matters involving water rights, to the effect that riparian owners have the right to full flow of the stream bordering their lands. In the last decade there has been a gradual change to acceptance of the beneficial-use doctrine adopted by the southern irrigation-using countries of Europe and by most of the so-called arid or Far Western states. This change in the State of Washington has been due to recognition of the fact that conditions and institutions of this country do not now justify adherence to the old English common law. The decrees handed down in recent years represent an interpretation applied to conditions in this country which is, according to R. K. Tiffany, state supervisor of hydraulics, "eminently progressive and practical."

Illustrating this change, the following is an excerpt from a decision handed down on May 8, 1928, by Judge E. V. Kuykendall of the Washington Supreme Court in a case involving water-right determination on the Walla Walla River:

> The necessity for and the benefits accruing from irrigation in the arid West in this utilitarian age have resulted in the abrogation of the old English view of riparian rights. The doctrine that a riparian owner was entitled to have the stream flow by his door unvexed and undiminished, even though he made no use of the water except to observe its beauty and listen to its babble, has been badly shattered by the materialistic courts of the Far West. Even our own Supreme Court, sordid and unpoetical as such a doctrine may seem, has adopted the view in late decisions that water is better employed growing onions and alfalfa than by reflecting the beauty of the moon while singing its way unvexed to the sea.
>
> In Proctor vs. Sim, 134 Wash. 606, the Supreme Court expressly repudiates the ancient doctrine that riparian owners were entitled to "have the waters lap their shores as they were by nature wont to do, undisturbed and undiminished," etc., and reaffirms the doctrine laid down in Brown vs. Chase, 125 Wash. 542, to the effect that "waters of non-navigable streams in excess of the amount which can be beneficially used, either directly or prospectively, within a reasonable time, or in connection with riparian lands, are subject to appropriation for use on non-riparian lands."
>
> No showing has been made that any riparian owner has been deprived of any rights which such doctrine implies, by the report of the referee, and the motion to reopen the case for further investigation of riparian rights is denied. The delay, confusion and expense involved in reopening the case would be appalling, and it is probable that the final report would approach no closer to the goal of substantial justice than the report now on file.

Water Main Extensions Should Conform To a Well-Considered Plan

By N. B. Jacobs

Of Morris Knowles, Inc., Engineers, Pittsburgh, Pa.

THE water-works distribution system must be carefully and comprehensively planned. The plan must not be altered to suit haphazard growth. Making extensions here and there as required to meet the needs of individual consumers and small groups of consumers is inadvisable.

If properly studied out, water-works extensions can fit in very well with the work of the city planning commission and with the requirements of the zoning ordinance. In new developments, recent experience has shown that water companies and departments will take the plan of lots and lay out proper distribution systems and then will work out with the developers of the property the method of financing the extension. Very often more liberal terms are made by the utility for extensions into areas which are on the low-level system than for hillside developments requiring repumping and booster stations.

A recent canvass of the water companies of Pennsylvania showed that, of those companies which had adopted a fixed policy, about half were requiring a cash contribution for main extensions, to be refunded either as a percentage of the revenue or as a lump sum for each new consumer taken on. The other half required a revenue guarantee of a certain percentage of the cost. The cash contribution method has worked out very well, in that it allows the utility latitude in making extensions where the analysis of the growth of the city and the community would indicate that there is very little likelihood of developing business.

City water departments, in their attitude toward making extensions which are not immediately profitable, hold in their hand, practically, the destiny of the community, and certainly can do much toward developing the city in an orderly and proper manner by having a comprehensive plan for water main extensions and then "sticking to it." Nearly all real estate operators realize that there is a certain lag or developmental cost in establishing water-works and that this capitalizes itself so that the water company or the municipality should have no fear in making extensions which are not immediately profitable.

Water companies, which always find the raising of additional capital a serious problem, should maintain fixed rules that permit them to decline to make an unprofitable extension where in their judgment it would appear that business would not develop readily enough to justify the expenditure.

It seems evident that by having a comprehensive plan of development, by having a study made of the future

growth and trend of the city expansion, privately owned companies and municipal water-works are alike able to justify their position in reserving to themselves the right to decide whether or not unprofitable extensions shall be made or contributed to by the utility.

Extremely Thin Dam Fails

Unreinforced-Concrete Structure Gives Way—Damage Done Is Negligible

INVESTIGATIONS by the U. S. Bureau of Reclamation of possible dam sites in the vicinity of Truckee, Calif., have brought to light the unreported failure of a small concrete dam used to impound a 35- to 40-acre ice pond of the Union Ice Company, which occurred this spring. As the ice pond had been abandoned and

FIG. 1—PROSSER DAM AND POND AFTER FAILURE

very little damage resulted from the release of the water, news of the failure did not become public.

The dam is on Prosser Creek about a mile above the point where it flows into the Truckee River and about 5 miles below Truckee. It is built of unreinforced concrete and has a thickness at the top of only 18 in. and at the bottom of not more than 36 in. The height is 35 ft., and the top length 100 ft. A highway bridge was formerly carried across the top of the dam, and a small power plant was installed just below. The structure was built on a slight curve downstream. Next to the power plant there is a spillway gate 5 ft. wide and 8 ft. high. The failure, which was only partial, occurred when the water rose above the dam and carried away the

FIG. 2—FAILURE INVOLVED PORTION OF DAM ABOVE CONSTRUCTION JOINT

Concrete slabs on left and in foreground account for all of missing part of structure.

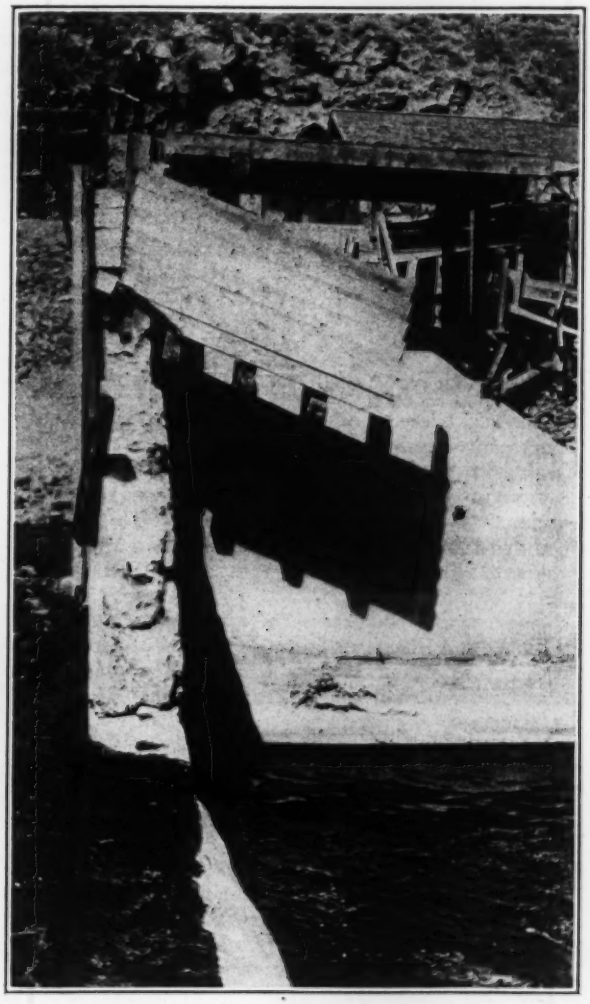


FIG. 3—SECTION OF DAM AT BREAK, SHOWING UNBONDED CONSTRUCTION JOINT

Thickness at top 18 in. At construction joint, 20 ft. Below, 24 to 27 in. No reinforcement used.

bridge. It is believed that the bridge and the spillway bay had buttressed the structure sufficiently to prevent previous failure. A portion 60 ft. long at the top, 30 ft. long at the bottom and 20 ft. high was carried away, the bottom of the break being at a construction joint at which, apparently, no attempt had been made to bond the concrete. Disposition of the blocks downstream is shown in Fig. 2, practically all the missing section being accounted for by the blocks shown. The concrete appeared to be of good quality.

Engineering News-Record is indebted to E. B. Debler, engineer for the U. S. Bureau of Reclamation, for this account and the illustrations which accompany it.

Waste Oil Aids Garbage Incineration

The use of waste motor oils from the garages of Utica, N. Y., as an aid to combustion in garbage disposal has resulted in greater efficiency. By raising the combustion temperature the oil gives more thorough combustion, resulting in a cost saving of about 60 per cent. Waste oil was formerly dumped in the sewer system, necessitating costly cleaning operations.

Degasification of Imhoff Tanks at Cleburne, Tex.

Floats in Dosing Chamber of Sprinkling Filter Remove and Compress Gas and Improve Tank and Filter Operation

By Chester Cohen

District Sanitary Engineer, Texas Department of Health, Austin, Tex.

UNTIL April of this year Cleburne, Tex., was facing several acute problems connected with the operation of its sewage-works. Stream pollution, odor nuisances, foaming Imhoff tanks, an overloaded secondary sedimentation tank and clogged sprinkling filter bed demanded immediate solution. This has since been accomplished by the degasification apparatus described in this article.

The plant consists of a double Imhoff unit, a dosing chamber, a sprinkling filter and a secondary sedimentation tank. The total Imhoff tank settling capacity is 5.4 hours, computed for an average daily flow, and the total sludge digestion capacity is about ½ cu.ft. per capita. The long retention period in the Imhoff tank, following the long interval elapsing before the sewage reached the plant, produced a septic sewage, high in hydrogen sulphide content. This undesirable condition was aggravated further by the relative inadequacy in the digestion compartment capacity, which caused belching of the solids upward into the settling chamber through the Imhoff slots. Under such conditions gassing and foaming of the Imhoff tanks frequently occurred.

The sprinkling filter, which is designed to handle the sewage at the rate of 1.75 m.g.d., is ordinarily adequate, providing it receives a properly prepared Imhoff effluent for oxidation. For some months it had appeared necessary to construct an additional Imhoff tank and provide greater filter-bed area. T. B. Simms, superintendent of the city sewerage system, and James G. Taylor, city commissioner, in studying the problem decided that degasification of the Imhoff liquor would send the effluent on to the filter in a much better condition and would thereby permit more efficient functioning of the filter.

To accomplish this as cheaply as possible it was decided to utilize the changing levels of the liquor in the dosing chamber to create suction on the Imhoff gas vents. To this end unique apparatus was devised by Messrs. Simms and Taylor which works automatically and is almost foolproof. Two floats (Fig. 1) working in parallel were placed in the dosing chamber. With the rise and fall of the liquids in the tank, the overhead apparatus for these floats is arranged to produce alternate suction and compression. On the suction stroke the dropping of the first float raises a galvanized metal tank, which floats within a slightly larger tank. (See Fig. 2.) Raising the inner tank creates a vacuum, which draws the gases from the top of the Imhoff gas chamber into the galvanized metal tank. On the compression stroke, as the float rises and the weight of the inner tank forces it down, these contained gases are compressed and discharged into the storage reservoir (Fig. 3) directly connected with the gas burner.

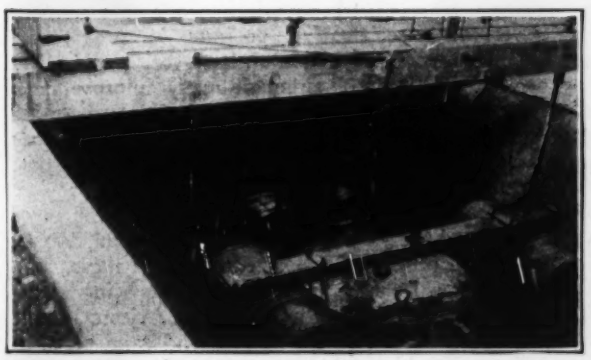


FIG. 1—FLOATS IN FILTER DOSING CHAMBER PUMP IMHOFF TANK GAS

FIG. 2—GAS SUCTION TANKS AND COMPRESSOR ADJOIN DOSING CHAMBER

Each tank contains a smaller floating inverted tank, which, acting with the floats, draws gas from the Imhoff tank, compresses it and discharges it into a storage tank, as stated in more detail in the text.

The pumps or floats work alternately so as to keep a constant suction on the gas vents and a constant pressure on the gas-burning line. When both pumps are working, a vacuum equivalent to about 12 in. of water is maintained on the gas vent; one pump creates a vacuum of about 6 in. Each float has its own tank for the suction and compression of the gas.

Special check valves (Fig. 4) between the suction and compression lines allow a one-way flow of the gas only, making the device work entirely automatically and without any cost for power and labor. The apparatus is simple. All equipment was designed and built in the city.

The gas drawn from the tank is of sufficient volume, when burning, to drive a 4½-hp. gas engine. This in itself will soon pay the cost of installing the device. Operation of the Imhoff tank has been greatly improved. Instead of building additional Imhoff tanks and filter beds, it has been found possible to cut one of the existing Imhoff units out of service and to operate with half the previous settling capacity. Foaming has been eliminated, thereby reducing odors remarkably. Lessening the retention period prevents the "souring" of the Imhoff tank liquor, augments the action in the digestion tank by a continuous removal of the gas and produces a very good Imhoff effluent. The sprinkling filter effluent compares favorably with the highest type of effluent from an activated-sludge plant. The final effluent has a stability of over 98 per cent, a B.O.D. of about 15 p.p.m. and a turbidity of not more than 12 p.p.m.

This method of degasification involves two interesting operating details: (1) The vacuum which is maintained on the gas vents of the Imhoff tanks serves to raise to the top levels considerable amounts of sludge, black and almost thoroughly digested. This sludge has no odor and is drawn off daily from the gas vents by

FIG. 3—GAS STORAGE TANK AT CLEBURNE SEWAGE-WORKS
Imhoff tank at right. Gas suction and compression tanks in rear.

gravity into an earth lagoon. No nuisance or fly-breeding results from this. (2) The vacuum maintained on the gas vents prevents quantities of sludge rising from the digestion chamber through the slots and into the sedimentation chamber. This gives a clearer Imhoff effluent, and considerably less gas is found in the effluent than would ordinarily form.

From the accompanying table it can be seen that the degasification process effects a reduction in turbidity of about 60 per cent, of color 30 per cent and more than 90 per cent of the settleable solids by volume.

Perhaps the efficiency of the process is still more strikingly shown by the fact that the effluent from the filter bed is extraordinarily good. With degasification going on, the filter is dosed with a higher quality of effluent than would ordinarily be produced. Consequently the filter in turn produces a highly purified effluent, as shown by the physical appearance and chemical quality. A study of the table will make this point clear.

RESULTS OF LABORATORY TESTS ON CLEBURNE PLANT SEWAGE
Thursday, July 12. 6-In. Vacuum. Only One Pump Working.

8:30 a.m.	Turb. P.P.M.	Color P.P.M.	pH	D.O. P.P.M.	Set. Sol. by Vol.	Temp., Deg. F.	H_2S P.P.M.	Stab. Hr.
Raw	20	70	7.7	1.5	2.5	80	0	18
Imhoff	35	50	7.1	0.0	0.1	81	...	0
Final	5	3	8.4	6.4	0.0	80	0	...
10:45 a.m.								
Raw	160	100	7.7	0.0	10.0	80.5	...	0
Imhoff	30	78	7.4	0.0	0.1	81.5	...	0
Final	5	5	8.6	5.8	0.0	82.5	0	..
11:30 a.m.								
Raw	250	400 (black)						
2 p.m.								
Raw	300	Black	7.35	0.0	....	83.0	2.0	0
Imhoff	120	Black	7.30	0.0	....	83.0	5.5	0
Final	10	Clear	....	....	....	....	0.0	0
Friday, July 13. 6-In. Vacuum. Only One Pump Working.								
8:30 a.m.								
Raw	30	150	7.6	1.0	0.4	82.5	0.0	10
Imhoff	45	130	7.3	0.0	0.1	83.0	7.7	0
Final	5	20	8.6	5.5	0.0	82.5	0	...
11 a.m.								
Raw	140	300	7.5	0.0	10.0	81.5	1.0	0
Imhoff	33	200	7.3	0.0	0.2	82.0	2.2	0
Final	5	30	8.6	6.5	0.0	81.0	0.0	350+
2:30 p.m.								
Raw	200	480	7.3	0.0	7.5	83.5	4.2	0
Imhoff	40	440	7.3	0.0	0.2	84.0	4.2	0
Final	10	50	8.6	5.4	0.0	86.0	0.0	0
5 p.m.								
Raw	150	420	7.3	0.0	....	....	3.5	0
Imhoff	75	350	7.3	0.0	....	....	4.0	0
Saturday, July 14. 12-In. Vacuum. Both Pumps Working.								
8:30 a.m.								
Raw	25	60	7.7	1.0	1.5	81.0	0.0	8
Imhoff	30	105	7.4	0.0	0.1	81.0	2.5	0
Final	5	3	8.4	5.9	0.0	81.0	0.0	0
11:30 a.m.								
Raw	250	420	7.4	0.0	10.0	82.0	3.2	0
Imhoff	40	125	7.3	0.0	0.1	82.5	2.0	0
Final	10	10	8.6	6.3	0.0	83.0	0.0	380+

B.O.D., p.p.m., one day at 30 deg. C.: Raw, 350; Imhoff, 200; final, 20.

By increasing the vacuum from 6 to 12 in. in changing from one pump to two, an increase in the efficiency of the gas vents is clearly seen by comparing readings of hydrogen sulphide for Friday and Saturday. Considerably more gas is drawn from the tank when a 12-in. vacuum is maintained, resulting in a better Imhoff effluent. A more rapid withdrawal of the gases of decomposition from the sludge seems to hasten the sludge digestion. Optimum conditions for bacterial action are evidently maintained by the elimination of inhibiting factors.

Conclusions—Field observations substantiated by laboratory experiments lead us to believe that further studies of this process may prove that: (1) Rapid removal of a part of the products of decomposition from the sludge speeds up the digestion process, thereby reducing sludge digestion tank capacity. (2) Increased vacuum is more effective than lower negative pressures. (3) Reduced gas vent areas are preferable to larger gas vent areas.

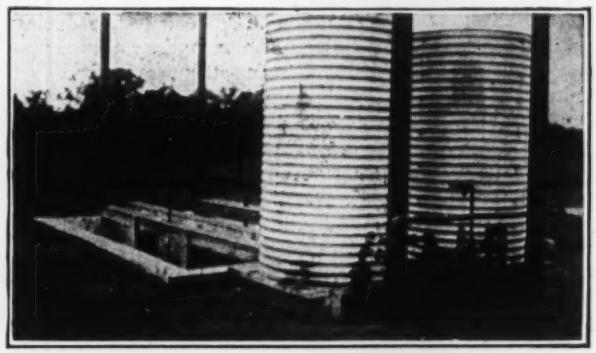


FIG. 4—CHECK VALVES OF GAS SUCTION AND COMPRESSION TANKS
Connected with each tank is a float, located in the adjoining dosing chamber that supplies the sprinkling filter.

(4) Removal of gases from thoroughly digested sludge does not retard drying. (5) Rapid removal of gas from digesting sludge effects a beneficial mixing and stirring of the sludge. (6) More rapid settling in the flow-through chamber of the Imhoff tank is obtainable. (7) Increased efficiency of sprinkling filters results because of an improved effluent from the sedimentation chamber.

If further study supports these conclusions, degasification of Imhoff tanks may revolutionize sewage treatment.

Progress Reports on Reclamation Projects

A recent report by Elwood Mead, commissioner of reclamation, states that construction work on a number of government reclamation projects is progressing rapidly. Settlement of idle land, however, continues to lag behind construction, although many improvements are being made on towns and cities included in the older projects. Among the structures now under construction are dams at Stony Gorge, Orland project, California; Gibson Dam, Sun River project, Montana; Oroykee Dam, Oregon-Idaho; Echo Dam, Salt Lake Basin project, Utah; and the Easton Dam, Yakima project, Washington. Good progress is reported on all of these. On the older projects many improvements are being made, including the resurfacing of a highway in Arizona, a new court-house in Yuma, Ariz., a brick and sand plant in Idaho, a new hotel in New Mexico, and a creamery and a telephone system in Washington.

Palestine Developing Electric Power

Three Diesel-Driven Stations Now in Operation—Work Under Way for Series of Hydro-Electric Plants—Storage Needed to Equalize Rainfall

By Allen B. McDaniel
Secretary-Treasurer, The Research Service, Inc., Washington, D. C.

THE important part played by reliable electric power at a reasonable cost in the development of modern civilization has been recognized by the government of Palestine in the granting to the Palestine Electric Corporation of a charter that is unique in the broadness of its provisions. This charter grants to the corporation for 70 years the exclusive use of the waters of the Jordan and Yarmouk rivers, the two major streams of the region, for hydro-electric and other purposes; the right to construct and operate electric railways, factories and other works; and partial relief from taxation.

Palestine is a country about the size of Vermont, with double the population. In latitude, topography and climate it closely resembles southern California, having orange groves at the foot of a mountain range, wheat fields in the upland valleys and a desert beyond. The country is largely mountainous, with occasional fertile valleys where the alluvial soil has accumulated for centuries. As the prevailing winds blow eastward from the desert, no rain falls for five or six months during the spring and summer. Government records show a general average rainfall of 21.3 in., of which less than 1 in. falls between May and October. The absence of forests, the steep, rocky slopes of the hills and the concentration of the rainfall into a few months make the question of storage paramount in considering hydro-electric development.

Initial Development—A comprehensive plan for the development of electricity in Palestine was drawn up about six years ago by Pinhas Rutenberg, civil engineer. Although the entire plan, which provides for complete utilization of the water power of the country, cannot be put into effect for many years, certain portions of it have already become a reality, and more will follow as the demand for current grows. Three Diesel-electric central stations are now in operation, and the first hydro-electric plant is under construction on the Jordan River. The stations already operating are as follows: Haifa, 1,000 hp.; Tiberias, 150 hp.; Jaffa, 800 hp. In all of these, generators are driven by Diesel motors operating on fuel oil. Three-phase alternating current is generated at 6,300 volts, transformed to 15,000 volts, and distributed by transmission lines to near-by towns within a radius of about 13 miles. For domestic and industrial use the current is stepped down to 220/380 volts. These power plants supply electric current at flat rates of 25c. per kilowatt-hour for lighting and 10c. per kilowatt-hour for power. The three stations will continue to operate independently until the water-power plant near Jisr-el-Mujamieh is in operation and able to supply current to one or more of these communities, after which they will be held in reserve for peak load and emergency uses.

Hydraulic Power Development—The initial step in the utilization of the waters of the Jordan River is the first stage project now under construction at Jordan Halt, near Jisr-el-Mujamieh, 7½ miles south of the efflux of the Jordan River from the Lake of Tiberias and about 1 mile south of the confluence of the Yarmouk River with the Jordan.

The general layout of this project is shown in Fig. 2. The principal features are the combined reservoir system created by earth dams across the Jordan and Yarmouk rivers about ½ mile above their confluence, the head race canal, and the power house.

The design of the reservoir system—now under construction—is based on the following basic hydrological data:

RAINFALL RECORD FOR 25 YEARS

Area	Average Annual Rainfall, In.	Watershed Sq.Mi.
Jordan River above Lake Merom	51.2	579
Below Lake Merom	19.7	465
Yarmouk River	11.8	2,316

The watershed area of the Jordan River is largely rough, hilly country denuded of trees and with considerable outcropping limestone. At the southern ex-

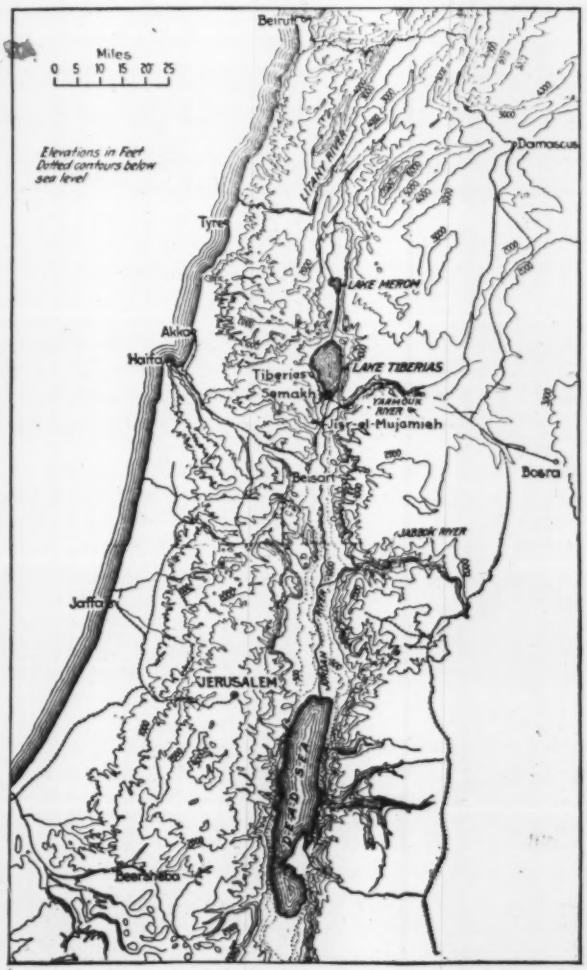


FIG. 1—PHYSICAL FEATURES OF PALESTINE

tremity of this area is the Lake of Tiberias, with an area of 65.6 square miles. No systematic gagings of the Jordan and Yarmouk rivers were made until 1925. The measurements since that time give the average flow of these rivers at stations near the project as 707 sec.-ft. and 636 sec.-ft. respectively. The Yarmouk is a typical flashy mountain stream with a range of flow of from 160 sec.-ft. as a minimum to 10,600 sec.-ft. as a maximum. The range of flow of the Jordan River (at the station below the Lake of Tiberias and thus regulated by this natural reservoir) is from a minimum of 177 sec.-ft. to a maximum of 2,300 sec.-ft. The combined flow of the two rivers as regulated and controlled by the reservoir system will make possible a minimum regulated supply of 1,166 sec.-ft.

The Yarmouk reservoir will have an area of 296 acres and an elevation of —731.7 ft. (All elevations are with relation to mean low water level of Mediterranean Sea.) This elevation will be maintained at a maximum height of 26.25 ft. by two automatic flood gates located near the east end of the dam. A cross-section of the dam and gates (indicating automatic method of operation) is given in Fig. 4. This type of flood gate is being successfully used in several large power projects in Germany. The Jordan River dam at Delhamia will create a reservoir with a length of nearly 2 miles and an average width of 820 ft. The water level will be —730.8 ft. Like the Yarmouk dam, this structure will be built of earth with a permeable gravel fill sufficiently strong to withstand full water pressure. A cross-section of the Jordan River dam showing type of construction is given in Fig. 5.

The Jordan and Yarmouk reservoirs are connected by a concrete-lined canal a little over a mile in length and having a capacity of 3,530 sec.-ft. This canal will have a system of sluices and a floodwater outlet located near the east end of the Delhamia dam.

The water will be drawn from the Yarmouk reservoir through a headrace canal 1,312 ft. in length, concrete lined, and capable of carrying a maximum flow of 5,650 sec.-ft. An interesting feature of the construction of this canal is the embankment, which will be built by dragline excavator and buck scrapers to templets set up on the ground surface. This canal discharges into a penstock or pressure basin composed of four chambers, each chamber closed with three sluices and feeding a steel penstock 114.8 ft. in length and with a discharge capacity of 1,166 sec.-ft. Each penstock opening is protected by a steel rack, which will be cleaned by back flow into a scouring channel to the Jordan River.

FIG. 3—A VIEW OF THE CONSTRUCTION CAMP, SHOWING THE TREELESS, HILLY NATURE OF THE COUNTRY

The power house is being built on the east bank of the Jordan River on a foundation of solid basalt. The building will have reinforced-concrete foundations and superstructure and steel roof framing. The present power equipment will consist of three units—vertical shaft turbine and generator of 8,000 installed horsepower each. The total installed plant capacity will be 24,000 hp., of which 16,000 hp. is intended to be active and 8,000 hp. reserve. A fourth unit will be added in the future, the size of which will be determined by the quantity of water available and the demands for power. The power house will utilize the unregulated waters of the Yarmouk River, supplementing them as necessary, especially during the summer drought period, with the water from the Jordan reservoir.

The tailrace canal will be dredged in the present bed of the Jordan River. The minimum water level of this canal will be —821.9 ft., while the maximum level of the headrace canal is given as —731.7 ft., giving a maximum head of 90.2 ft. The general layout of the works, including headrace, pressure basin, penstocks, power plant and tailrace, is indicated by Fig. 6. The plant is designed to use a minimum of 1,166 sec.-ft. and a maximum of 5,650 sec.-ft. on peak loads.

The Jordan-Yarmouk and the headrace canals pass under the railway from Haifa to Semakh and the highway from Semakh to Beisan, necessitating specal concrete-steel structures at these crossings to carry both railway and road.

The current generated at this power station wlll be at 6,300 volts; it will be stepped up to 66,000 volts and carried to Haifa and Jaffa by permanent transmission lines of steel towers on concrete bases. Secondary transmission lines will carry the current, at 22,000 volts, from the

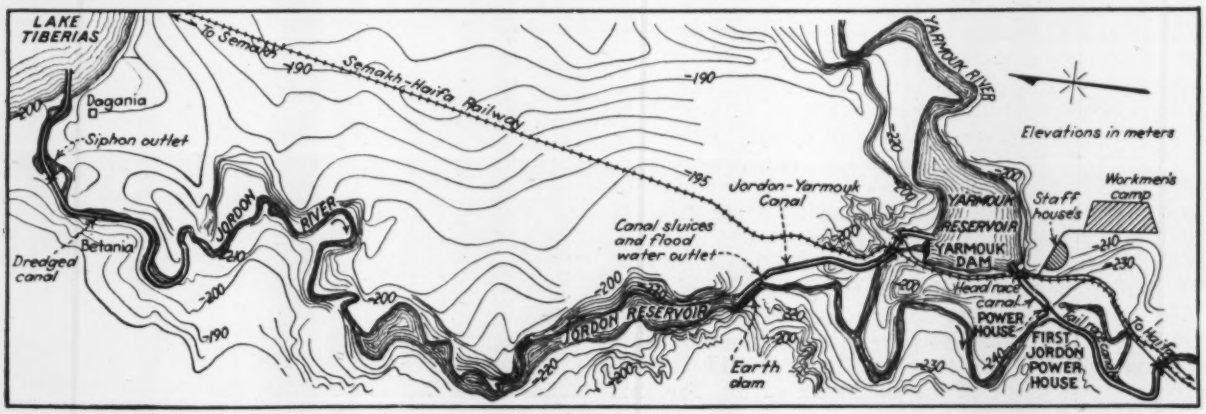


FIG. 2—GENERAL PLAN OF THE HYDRO-ELECTRIC PROJECT UNDER CONSTRUCTION AT JORDAN HALT

main Haifa and Jaffa transformer stations to the communities using the current for light or power or both, and will there be stepped down to 220/380 volts for local use.

Construction—The construction plant includes a building containing the mess and recreation hall, kitchen, laundry and refrigeration plant; a temporary power plant of 650-hp. capacity; a wood workshop; storehouse; hospital; water, gasoline and oil tanks, and minor structures. The water and oil tanks are located on a hill about 70 ft. above the camp, the structures of which are supplied with electric current, water or oil, as may be required.

The present initial project includes the handling of 917,000 cu.yd. of earth and rock; the placing of 65,500 cu.yd. of concrete; the building of 40 miles of high-tension transmission line, 31 miles overhead and 9 underground, and of 62 miles of low-tension lines; and the construction of 25 transformer stations of 3,000-kva. capacity. The excavation of the canals and pressure basin is being done with mechanical equipment, including two steam shovels with 1¾-yd. buckets, two dragline machines with ½-yd. buckets, a locomotive crane with a grab bucket of ¾-yd. capacity, seven locomotives of 60 hp. each and several hundred industrial steel dump cars of ¾-cu.yd. capacity.

Labor—One of the unique features of this power project on the Jordan is the use of Jewish and Arab labor. During an inspection of the work early in February, 1928, the writer saw about 300 young Jews—men and women—engaged in every class of labor from wield-

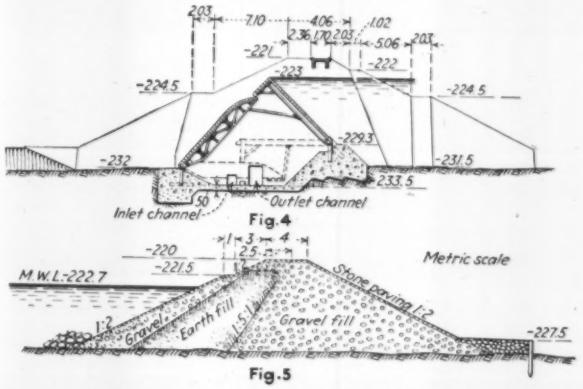


FIG. 4—SECTION THROUGH AUTOMATIC DISCHARGE WEIR OF YARMOUK DAM. FIG. 5—TYPICAL SECTION OF EARTH DAM ON JORDAN RIVER

ing pick and shovel to operating a steam shovel in the construction operations, and from waiting on table to nursing. At this time 50 Arabs were employed in the excavation of the foundation for the power house. It was an unprecedented sight to see these "people of the desert" engaged in severe sustained manual labor.

Special housing has been built for the employees, and room and board are supplied at cost. On the high plateau above the river valley, the corporation has built two groups of houses; one containing 12 houses for the staff, and the second comprising 28 houses for the employees. The latter are not allowed to have their families on the job on account of health conditions. The corporation has expended $10,000 in draining and oiling the low-lands just above the confluence of the rivers to prevent the occurrence and spread of malaria. The housing has been especially designed and built to provide comfortable living quarters in a country subjected to high winds and intense heat during the summer months. Walls and floors are of concrete and the roofs of tile with sufficient overhang to shade the windows during the heat of the day. Each group of houses is arranged to face the prevailing summer winds (which furnish the only relief from the intense, dry heat), and is landscaped to supply attractive environment and shade.

Subsequent Developments—The Palestine Electric Corporation contemplates a series of developments in the utilization of the waters of the Jordan Valley subsequent to the completion and operation of the initial project at Jordan Halt, as conditions warrant. These developments are as follows:

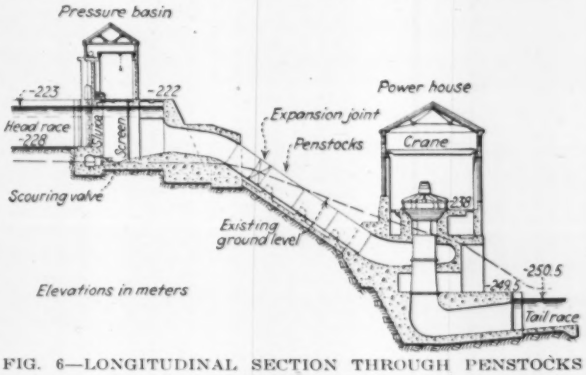


FIG. 6—LONGITUDINAL SECTION THROUGH PENSTOCKS AND POWER HOUSE

1. The diversion of the waters of the Yarmouk River into the Lake of Tiberias so as to conserve the flood-waters of this stream.

2. The further deepening of the Jordan River to a maximum depth of 23 ft. from Lake of Tiberias to carry the regulated waters of both rivers.

3. The construction of a second hydro-electric unit at Abadiek. This plant will have a tailrace elevation of —730 ft. and a headrace level of —659.5 ft., and will use about 1,590 sec.-ft. of the combined flow of the two rivers. After the construction of this plant the waters of both rivers will be conducted through the enlarged channel of the Jordan through the turbines of both power houses at Abadieh and Jisr-el-Mujamieh.

For the basic data of this article the writer is especially indebted to Mr. Rutenberg and his associates of the Palestine Electric Corporation, Ltd.; Joshua Gordon, and S. D. Sorsky, of Haifa, Palestine.

Data on Tall Concrete Buildings

A survey recently completed by the Portland Cement Association shows that there are 647 reinforced-concrete buildings over ten stories high in this country, with an average number of stories of 11.9. The first concrete building above ten stories in America, the Ingalls office building at Cincinnati, Ohio, finished in 1903, stands sixteen stories. According to the survey, the Hotel Palacio Salvo, at Montevideo, Uruguay, is the tallest reinforced-concrete building in the world, having 28 stories and being 338 ft. above the sidewalk level. It was finished in 1926. The tallest concrete building in the United States is the recently completed Master Printers Building, New York City, which has twenty stories and an over-all height of 310 ft. Illinois is the leader among states in construction of tall concrete buildings with a total of 110; California is second with 67; Texas is third with 57; and New York fourth with 47.

Asphalt Replaces Wood as Filler in Paving Track

Former Method of Construction Had Short Life in Service—Failure Partly Due to Lean Concrete

IN REHABILITATING the street-car tracks in Salt Lake City reinforced-concrete slabs are being placed at each side of the rails. Immediately adjacent to the rails, however, is a heavy strip of asphaltic felt fitting directly under the rail head. This filler takes the place of a wood filler utilized in earlier construction with a view to preventing the slabs from breaking up from the vibration of passing cars. The slabs are 4 ft. long,

FIG. 1—ASPHALT FILLER BETWEEN RAIL AND CONCRETE
Note chamfered edge on precast slab inside of track.

12 in. wide and 4½ in. deep, those on the inside being chamfered along the top edge next the rail. End joints are filled with hot asphalt tamped in, but every 50 ft. a felt filler is inserted.

In similar construction four years old the outside slabs were 15 in. wide and the thickness of all of them 4 in. Also, wood strips were used as fillers under the rails. H. C. Jessen, city engineer, is of the opinion that failure was due as much to the use of too lean a

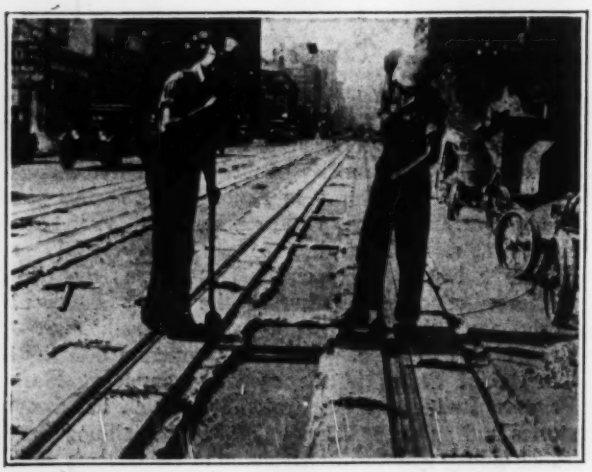


FIG. 2—TAMPING JOINTS BETWEEN SLABS
Asphalt used here also. The precast slabs were bedded in concrete.

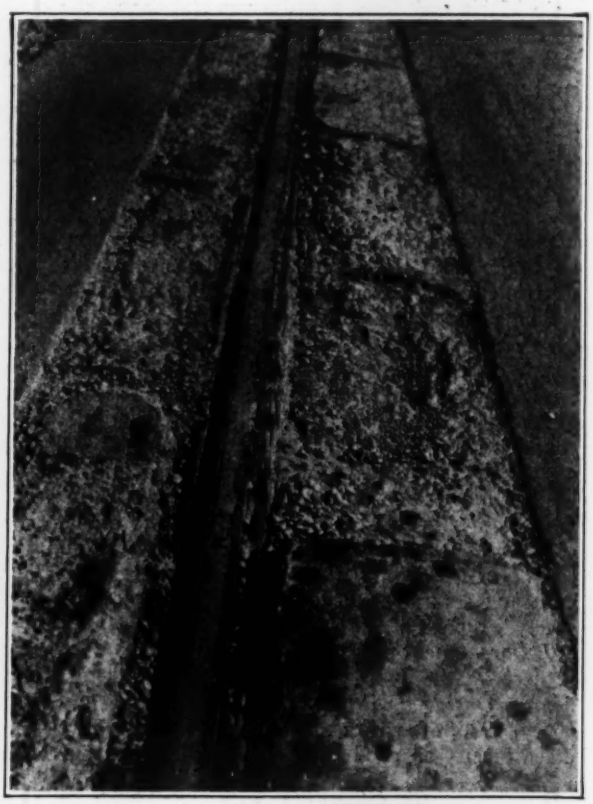


FIG. 3—WOOD-FILLER CONSTRUCTION AFTER FOUR YEARS OF SERVICE

mix of concrete as to the shattering action from vibrations set up by passing cars. More reinforcing is being used in the new slabs and the mix is made richer. The work is being done by the local street-car company in Salt Lake City.

Canada Rapidly Developing Water Power

Data compiled by the water-power and reclamation service of the Canadian Department of the Interior indicates that during 1928 turbines totaling 550,000 hp. will be installed in new hydro-electric developments or in addition to present stations in various parts of Canada. It is predicted that within the next few years completion of water-power projects now in process of development will add to the resources of the dominion a total of more than 2,000,000 hp., requiring an investment of more than $200,000,000. Most of the larger projects are sponsored by the lumber and paper-making industries, although a few are under public ownership.

Definition of an "Irresponsible Contractor"

The winning definition of an "irresponsible contractor" in a contest conducted by W. A. Bechtel, national president of the Associated General Contractors, was "One who takes a job for which he is not experienced, or for which he has not the suitable equipment and sufficient capital to finance it, or at a price which does not insure to him a reasonable profit, is an irresponsible contractor." Many other excellent definitions were submitted in this contest. The winning definition was submitted by C. T. Malcom, of Walnut Creek, Calif.

Arch Bridge Unusual in Design and Construction

Precast Units Used to Control Shrinkage and Eliminate Bending Moments—All Falsework Based on Cable Support Only

By W. L. Scott
Chief Engineer, Considere Constructions, Ltd., London, England

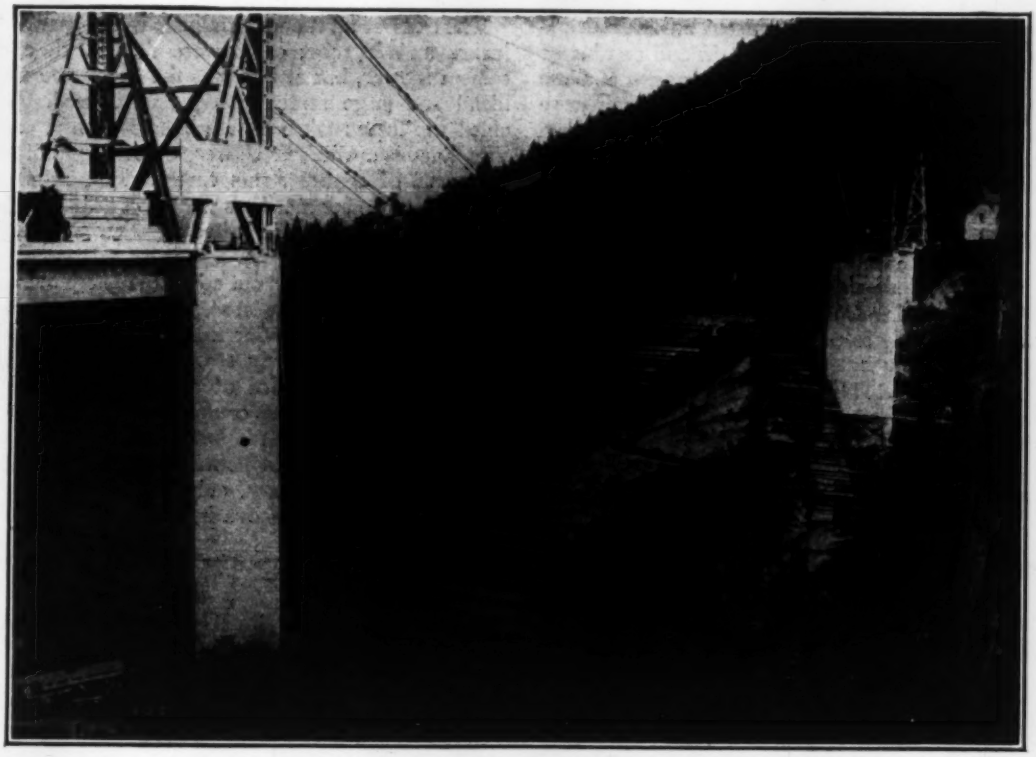


Fig. 1—First Step in Erecting Timber Arch Falsework

THE Pont de la Caille, now nearing completion, is situated on the road between Annecy and Geneva in the Southeast Department of France. It is a 450-ft. single arch bridge spanning a gorge 480 ft. deep. The abutments are founded in rock, which made this type of bridge suitable to the site but left the question of construction a somewhat difficult problem. This, as well as size and location of the bridge, influenced the form of construction.

The main arch is of the fixed or encastre type, but owing to its proportions no longitudinal tensile stresses are produced anywhere in the arch. Consequently, all longitudinal reinforcement could be dispensed with, and this made it possible to compensate in a somewhat novel manner for the effects of shrinkage, as well as for the secondary effects due to load compression. The deformation in an arch of this size due to the causes mentioned is rightly regarded by French engineers as of greater importance than the stresses produced by the loads to be carried. The cumulative effects of shrinkage, dead weight and elastic compression cause an arch axis to shorten and its curve to flatten. At the same time, the springings of the arch tend to rotate. In cases where the arch is monolithic with its abutments, these deformations are resisted and, if no compensations are made, serious bending moments are thereby induced in the arch members. It should be noted that the bending moments referred to are not those produced by the traffic passing over the bridge, but are the result of the fixed arch changing its curvature when it is flattened. It is not easy in a short description clearly to explain the method of compensation adopted in designing this bridge, but the following remarks should enable the reader to follow the principle involved.

If, in an arch, the shrinkage can be controlled and varying deformations can be produced along its length so as to counteract the deformations produced by arch shortening, the resultant thrust will be axial at all cross-sections and no bending moments will be produced. It is clear that the longitudinal shrinkage of a concrete member can be controlled in amount by introducing into it precast units placed at intervals. The greater the number of units the less the total diminution in the length of the member. Similarly, by distributing precast units through the depth as well as through the length of the member, its final shape can be controlled to some extent.

The arch of the Pont de la Caille is of cellular form, composed of a bottom slab, ribs and top slab. In each

of these, precast transverse units are so arranged as to counteract the deformation already referred to. The precise arrangement of these precast units necessitated considerable theoretical study. The drawing furnished to the contractors showed the precise spacing of the precast units, which were placed crosswise on the timber centering before the concrete pouring was begun. Similar units were interposed in the vertical ribs and crosswise in the top slab.

The remainder of the construction was of the usual type and calls for no comment. The method employed in the construction of the main arch falsework, however, is interesting. First, there was erected an aerial ropeway transporter having a span of 600 ft. and capable of carrying a 2-ton load. The approach viaducts and the main piers over the springings of the main arch were then constructed. (See Fig. 1.) Superimposed upon these piers timber-framed towers were erected, and from these were slung a series of steel cables, spanning the gorge. These cables rested upon concrete saddles on top of the timber towers, and were anchored back to concrete blocks embedded in the ground on either side of the roadway. Along the cables were vertical suspenders, having at their lower ends a series of timber cross-joists arranged roughly to the intrados curve of the arch but about 15 ft. below it. (See Fig. 1.) These cross-joists were then connected by boarding upon which transverse timber strips were nailed, forming a light working platform. This platform was only strong enough by itself to support a limited load of two lines of longitudinal beams, each consisting of three 7x14-in. timbers separated by chocks, to allow for the insertion of the diagonal shear members. The addition of this longitudinal stiffening strengthened the work sufficiently to enable it to carry further groups of timber longitudinals similarly arranged. The sequence of construction is shown in Fig. 3.

The top of the falsework was practically a repetition of the lower portion. The cross-timbers, resting on the top longitudinals, carried the boards forming the bottom of the forms. To prepare a smooth surface to the exact curve required for the underside of the permanent arch, the boarded surface was screeded with a thin layer of weak concrete.

The ends of all the longitudinals were separated a few inches and in most cases were filled with aluminous cement mortar, but at intervals the ends were shod with metal and large folding wedges introduced. This enabled the thrust taken by any member to be controlled. The diagonals which fit between these longitudinals were composed of central struts embraced on either side by two thinner timber members which act as ties. The three diagonal members were bolted together at every intersection.

This description does not cover the many points of detail that had to be considered, but it illustrates in principle how the falsework for this enormous structure was erected from cables only strong enough by themselves to carry about one-third of the weight of the timber arch. Incidentally, the complete arch was only sufficiently strong to carry the bottom slab of the box vault which formed the main permanent arch. The concrete bottom slab was, in turn, only capable of carrying the concrete immediately above it, and so on. In the early

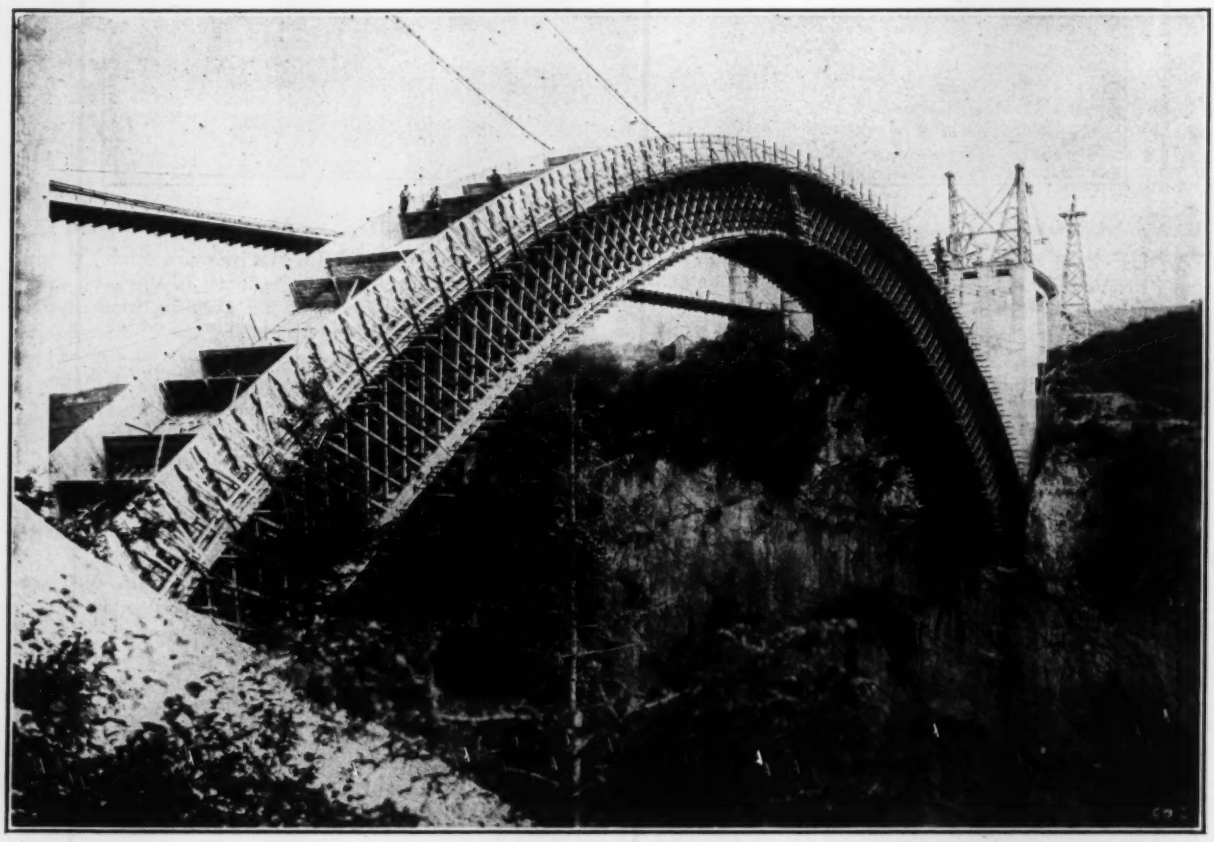


FIG. 2—FALSEWORK AND FORMS COMPLETED, READY FOR CONSTRUCTION OF LOWER RIB OF ARCH

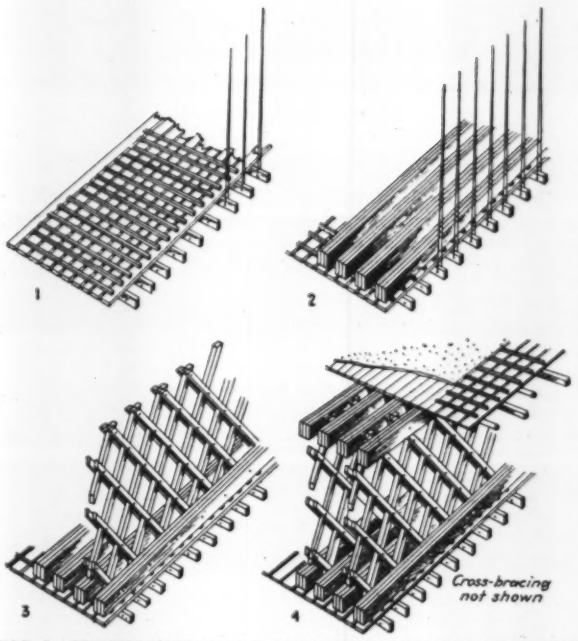


FIG. 3—SUCCESSIVE STEPS IN ASSEMBLING TIMBER ARCH

stages of erection certain lateral stiffening was provided by cables. Fig. 2 shows the completed falsework.

The Pont de la Caille was designed by the French firm of Pelnard-Considere et Caquot, which also planned the method of construction.

Ice Fractures Concrete Gate Tower

A recent report of the Bureau of Reclamation describes the fracture of a 152-ft. concrete gate tower at the Magic reservoir on the Big Wood River near Shoshone, Idaho, by ice. The reservoir is owned by the Big Wood Canal Company and is not a government reclamation project. The report describes how, last March, the leakage of a large volume of water from the outlet tunnel and the presence of water in the normally dry operation chamber of the tower led to an investigation which revealed that the tower had been ruptured at the base. At the time the tower appeared to be plumb, but later it was observed that it had assumed a leaning position, being several feet out of vertical at the top. The tower gradually settled back into place, while the flow of water was reduced from 370 sec.-ft. to about 15 sec.-ft. It is believed that the entire tower was lifted vertically from its base by an ice sheet which rose with the water in the reservoir. Then the tower must have broken through the ice on the side facing the dam, and, finally, settled back to plumb almost exactly in place. The tower is an octagonal structure about 20 ft. in diameter, with a dividing wall in the center, and is located at the upstream toe of the earth dam. Steel was not used in tying the tower to its base where the rupture occurred.

Temporary repairs were made by a diver, who calked the leak and determined that very little damage to the gate-control apparatus had resulted. Permanent repairs were deferred until the water could be drawn down by irrigation use. A temporary bulkhead of 12x12-in. timbers was fitted to the interior walls of the operating compartment of the tower, being spaced so as to reduce the chance of lateral movement.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Drainage Ditch Maintenance

Sir—On p. 935 of your issue of June 14, 1928, in the article "Imperial Valley Silt Creates Problem in Drainage Ditch Maintenance" it is stated: "As long as the drainage ditch is below the level of the pervious strata there is little that can be done to prevent the sloughing off of the steep silt faces."

There are two methods to meet such conditions, of which the direct method (bracing) is rarely successful, whereas the indirect method—collecting the water by pipe (tile) drains which discharge into the main drain, thereby lowering the water table—is generally successful where the high lying pervious strata are localized.

C. C. INGLIS,
Superintending Engineer,
Irrigation Development & Research Circle.

Poona, India,
July 20, 1928.

Henry Jackson Burt—An Appreciation

Sir—In the obituary notice of Henry Jackson Burt, in *Engineering News-Record* of Aug. 9, p. 224, you give a rather complete account of his activities, but it occurred to the writer, since Mr. Burt had a standing in the structural engineering profession above the average, that the readers of *Engineering News-Record* might be interested in a somewhat more personal appraisal of Mr. Burt's abilities and achievements by one who has had rather close contact with him. The writer had been associated with Mr. Burt during most of the past seventeen years and feels that Mr. Burt's death is a distinct loss to the engineering profession. Mr. Burt's ability had long been recognized by those with whom he came in contact. He had abilities other than technical knowledge necessary to make a successful engineer.

Along with an exceptionally well-grounded knowledge of engineering principles and a thorough understanding of their practical application, he had other characteristics that make for success. His manner was quiet and unassuming. His integrity was never questioned. He was sane and logical. He was never hurried or stampeded. He was modern and progressive, but never radical or spectacular. He was never overconfident, yet was thoroughly posted. He was well poised.

Mr. Burt had a keen analytical mind and the habit of attacking a problem in a calm, cool and collected manner that was certain to produce a proper solution. He was a good organizer and a very capable executive. His manner was one of guidance and direction and never dictatorial. He was always ready to listen to the suggestions of his assistants. He sought the best solution for a problem and never hesitated to adopt the suggestions of his assistants or associates if they gave promise of better results. He always gave credit wherever due. If an assistant made an error, Mr. Burt took the responsibility himself and then reasoned it out with the assistant so that it would be a lesson and a resulting gain to the latter. Mr. Burt's manner tended to bring out the best in his assistants and associates and their progress and responsibility was in direct relation to the ability shown. Those who were associated with Mr. Burt were fortunate indeed and undoubtedly the better for such association.

Mr. Burt was very versatile. His interests were not limited to structural engineering problems. He was well posted on business principles and a capable organizer in anything he attempted. His versatility is evidenced by his success in going progressively from construction work on the Chicago & Northwestern Railroad and surveys for the Chicago & Western Indiana Railroad to teaching as assistant professor of civil engineering at Iowa State College, to

designing and estimating structural steel and later to the management of sales and contracts for the American Bridge Company, and from there to responsible charge of structural design work as chief engineer for the architectural firm of Holabird & Roche.

Later this is again evidenced by his progress from structural design to the U. S. Army, during the World War, as an executive in the U. S. Quartermaster Department at Washington, being commissioned as major at the beginning of the war. At the end of the war he went back to Chicago as general manager for Holabird & Roche, and finally to a successful consulting engineering practice in Chicago.

Mr. Burt started his work as chief engineer for Holabird & Roche at a time when building construction was developing very rapidly into the modern type. Many of the buildings he designed during that time, while not at all remarkable today, were advances on previous construction. New materials and methods of construction were being adopted, making computation more difficult, while the increasing of building heights made consideration of wind stresses more important.

At such a time, therefore, the service rendered to the public and profession by a man of Mr. Burt's character and ability was especially valuable. This usefulness was the more widely extended since he found time in the midst of his other activities to make many contributions to the literature of the profession. He contributed a number of articles to the several engineering papers and presented several papers to the engineering societies. His book on "Steel Construction" has had wide circulation.

During his service as chief engineer for Holabird & Roche, from 1911 to 1917, he was responsible for the structural design of many buildings; among them were the Century Building, the Roanoke Building, the Commonwealth Edison northwest station, section 6 of the Boston Store, the Fort Dearborn Hotel, the Franklin Telephone Office Building, the Crane Office Building, all in Chicago; and the Wisconsin Hotel, Milwaukee, Wis.; the Deshler Hotel, Columbus, Ohio; and the Muehlbache Hotel and the John Taylor store in Kansas City.

As consulting engineer from 1920 to 1928 he was connected with some of Chicago's largest buildings—namely, the Chicago Temple, the Tribune Tower, 34 stories; the Morrison Hotel, 45 stories; the Sherman House, 26 stories; the Roanoke Tower, 37 stories; the New Palmer House, and the Stevens Hotel. All of these buildings had special problems in deep foundations, in wind bracing and in truss and girder work, due to the large public spaces. Perhaps the most notable is the Stevens Hotel, in which a banquet room was provided on the second floor, 85x170 ft., with a clear height from the second to the fifth floor. This required the use of some unusual truss, girder and column work for the support of 53 columns, carrying the eighteen stories above. An article describing this work and showing illustrations of the pin-connected trusses used was published in *Engineering News-Record* of April 22, 1926. He also was consulting engineer on several stadiums, including the Illinois University stadium, the Chicago University stadium and the Grant Park stadium.

Mr. Burt's work as consulting engineer, while largely on structural design of buildings for Holabird & Roche and other architects, was not limited to structural problems. He participated in industrial organization and factory building for the Celotex Company, along with the investigation and development work on that product. He was also a consultant for the investigation and development of other materials of construction. He was employed in several cases as consultant on general business problems, particularly where related to engineering.

The members of the Western Society of Engineers recognized Mr. Burt's abilities and willingness to serve in the society activities soon after he became a resident in the Chicago district. He gave much of his time to the society, serving on various boards and committees and as president in 1917. His work as chairman of the legislative committee of the Western Society of Engineers for 1914 and 1915 is especially notable, since this committee handled the society's work on the engineers' license law for the State of Illinois.

It is indeed unfortunate that a man of Mr. Burt's abilities and character should leave us so soon. His loss is very keenly felt by his friends and associates.

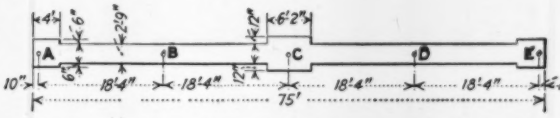
Chicago, Ill., Aug. 16, 1928.

F. E. Brown,
Smith & Brown Engineers, Inc.

Method of Design for Continuous Column Footings

Sir—In your issue of Aug. 16, p. 237, is an article by Norman B. Green, which I have read with interest, in which he proposes a method of design for continuous column footings to take the place of the usual methods based on the equation of three moments. All known practical methods of calculating distribution of bearing area are necessarily based on arbitrary assumptions, but I should like to call attention to two assumptions made in that article that seem contradictory.

In his example the author assumes that the beam is of uniform width and also that the upward pressure per linear foot of foundation is uniform. This can be only when the



loads are in the same ratio as the supports of a continuous beam, in which case the method of three moments is applicable.

Taking his example and assuming that the effect of the 10-in. cantilever on the interior supports is negligible, the loads that would induce a uniform soil pressure are 175,000 lb. for columns A and E, 320,500 lb. for columns B and D and 246,000 lb. for column C. To have an approximately uniform soil pressure with the given loads, spreads will be required, as shown in the accompanying plan, at A and E for the additional 24,200 lb. and at C for the additional 74,500 lb. Here we make the assumption that the additional loads at A, C and E will be distributed evenly under the spreads. The calculations of moments under this assumption is given below.

Loads inducing soil pressure = 175,000(2) + 320,500(2) + 246,000 = 1,237,000 lb.
Area required = 1,237,000 ÷ 6,000 = 206.17 sq.ft.
Width required = 206.17 ÷ 75 = 2.75, or 2 ft., 9 in.
Soil pressure = 1,237,000 ÷ 75 = 16,500 lb. per linear foot.
Additional areas at A and E = 24,200 ÷ 6,000 = 4.03 sq.ft.
Additional areas required at C = 74,500 ÷ 6,000 = 12.41 sq.ft.
Soil pressure per linear foot at A and E = 16,500 + (24,200 ÷ 4) = 22,550 lb.
Soil pressure per linear foot at C = 16,500 + (74,500 ÷ 6.17) = 28,550 lb.
M_B = 199,200(18.33) — [16,500(19.17)² ÷ 2] — 24,200(17.17) = + 210,000 ft.-lb.
M_C = 199,200(36.67) + 320,500(18.33) — [16,500(37.5)² ÷ 2] — 24,200(35.5) — [12,050(3)² ÷ 2] = + 1,771,800 ft.-lb.
M_{AB} = 199,200(9.17) — [16,500(10)² ÷ 2] — 24,200(8) = + 728,400 ft.-lb.
M_{BC} = 199,200(27.5) + 320,500(9.17) — [16,500(28.33)² ÷ 2] — 24,200(25.5) = + 1,083,000 ft.-lb.

From a consideration of these figures and those given in the article referred to, it is evident that in order to use the proposed method with economy it is necessary to assume that the load at C is distributed uniformly without adding a spread at that point.

New York City, Aug. 21, 1928.

J. J. Del Bourgo,
Consulting Engineer.

Sewer Construction in Wet Ground: Correction

In the title to Fig. 6 of the article on sewer construction at South Bend, Ind., in *Engineering News-Record* of Aug. 2, p. 175, a line was omitted. This description should read as follows:

"Drag-line machine with 3-yd. bucket is excavating the trench. A crane at side of cut handles a grab bucket excavating to grade inside the shield and also lowers the 80-in. pipes into place. Another drag-line machine follows as a backfiller."

News of the Week

Southern Pacific Seeks Permission to Bridge Suisun Bay, California

Structure to Replace Car Ferry to San Francisco—Will Cost $11,548,500

AT A public hearing on Aug. 21 before representatives of the U. S. War Department in San Francisco, the Southern Pacific Railroad Company made application for a permit to build a railroad bridge across the western end of Suisun Bay (an arm of San Francisco Bay) to replace the car ferry now operating between Benicia and Port Costa. Numerous indorsements of the project from civic organizations were presented and no protests or objections were received.

A report and order of the Interstate Commerce Commission dated Aug. 27 approves the project, including 6.1 miles of new trackage necessary to connect with the present main line.

The train ferry to be replaced began operation 48 years ago. Traffic has increased to such an extent in recent years that excessive delays are now entailed at this crossing, particularly when fog slows up ferry operation. The ferry is used by all trains to and from the San Francisco Bay region via the Shasta route to the north, as well as over the company's main transcontinental route.

The proposed bridge is to be a double-track structure consisting of ten 408-ft. through spans, one lift span with a 305-ft. clearance between piers, one 390-ft. deck span and short viaduct approaches at both ends, the total length being 6,000 ft. All through spans will be 70 ft. in the clear above mean higher high water and the raised lift span, designed to open in 90 seconds, will give a clearance of 135 ft. Designs are worked out for double-headed locomotives equivalent to Cooper's E-90, followed or preceded or both by a uniform load of 7,500 lb. per linear foot.

The cost of the structure is estimated at $11,548,500 and railroad officials state that, if and when War Department sanction is received, the call for bids can be issued immediately.

Santa Fe Given Permission to Buy Orient Road

A decision of the Interstate Commerce Commission dated Aug. 28 approves of the proposed purchase of the Kansas City, Mexico & Orient Railroad by the Atchison, Topeka & Santa Fe by the acquisition of capital stock. The approved price is $14,507,500. The Orient has been in the hands of receivers since 1912, with the exception of two years. On several occasions the abandonment of the line has been considered. It has a total length of 735 miles, and the commission finds that only 5 per cent of the business of the line has been competitive with the Santa Fe. The two lines join at eight points, and it is expected that by combined operation, a saving of 235 miles will result to through traffic.

Large Pump Installation for Irrigation District

The West Stanislaus Irrigation District in the San Joaquin Valley, California, is now installing seventeen electrically driven pumps to raise water 23 to 30 ft. from river level to the canal system. All of the pumps are the Pelton-Moody spiral type rated for delivering 42 sec.-ft. Three, which will deliver against heads of 30 ft., are driven by 200-hp. motors and are being installed at the junction of the Stanislaus and San Joaquin rivers. The fourteen others, delivering against heads of 23 ft., are driven by 150-hp. motors and are distributed among five other pumping stations. Ultimately eleven more pumps of the same type will be added. These pumps, which are the first of this type installed on a California irrigation project, are supplied by the Pelton Water Wheel Company of San Francisco.

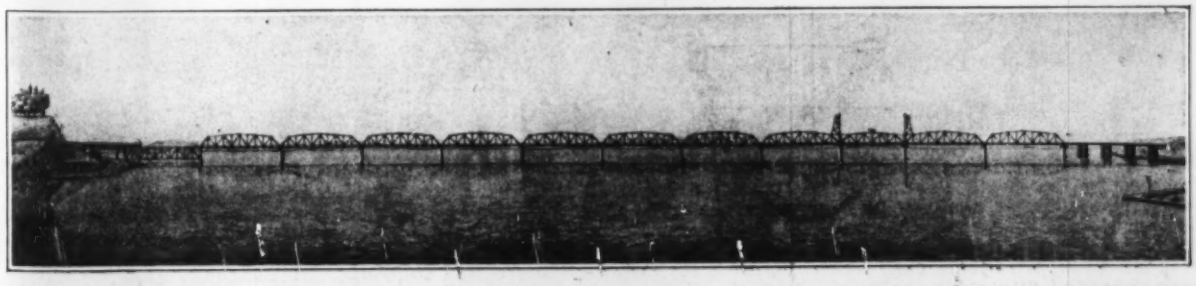
Open Switch Wrecks a Rush-Hour Train in New York Subway

Rear Truck of One Car Takes Turnout Switch—Two Cars Smashed Against Partition Wall

JUST as the rush-hour crowds were beginning to fill the trains of the Interborough Rapid Transit Company subway at New York on the evening of Aug. 24 the two rear cars of a southbound express train leaving the Times Square station were derailed at a switch south of the station and thrown against a partition wall separating the express track from an intermediate storage track to which the switch leads. The force of the impact was so great that one car was nearly broken in two and the following one was badly damaged. A number of people were killed and a great many seriously injured. To date the total number of dead is seventeen.

Times Square at the evening rush hour is a turn-back point for trains of empty cars coming down from the storage yards. These trains come down between the regular express trains and after they have passed beyond the south end of the island platform they are run through a facing-point turnout into a storage track. From there they are turned north into the northbound express track to be loaded.

From the statements of those concerned, it appears that after one of these trains had passed into the storage track it was found that the towerman could not close the switch to clear the main line for the next express train, then standing in the station. Consequently one of the maintenance men went to the switch and by manipulating the controls at the switch was able to close it. Thereupon he signaled to the train to proceed while an assistant held down the tripper of the automatic train stop, the signals still being at danger due to the breakdown of the operating mechanism of the switch. As the train passed



PROPOSED RAILROAD BRIDGE ACROSS SUISUN BAY, CALIFORNIA, TO REPLACE BENICIA-PORT COSTA TRAIN FERRY

over the switch, gaining momentum as its speed increased, the switch opened again after the forward truck of the ninth car had passed. When the rear truck came along it took the switch, swinging the car over against the end of the concrete and steel partition between the tracks. The tenth, and last, car of the train followed into the turnout and its momentum, added to that of the other car, almost broke the ninth car in two at the middle. Short circuits which occurred before the power was shut off filled the subway with acrid fumes, but no fire of any consequence occurred.

It is not known what caused the switch to open. The wheels and truck of the ninth car were found to be in good condition and there was no evidence to indicate that one of the wheels split the switch. The general belief is that either the manipulation by which the switch was closed was not successful in holding it closed, or else some manipulation of the control levers in the interlocking tower counteracted the action by which the switch had been closed.

Damage to the columns between the tracks was not serious enough to endanger the structural support of the roof, nor to interfere with surface traffic.

Farm Group Completes Successful Irrigation System

Without borrowing a cent of outside capital, a group of farmers in western Nebraska have completed the construction of an irrigation system costing $350,000 and serving 15,000 acres of land. The main feature of the project is a 33-mile canal which leaves the Platte River 10 miles north of Gothenburg, Neb. A construction company was formed by 121 landowners who would benefit by the project. The company had plans prepared and let the work on a contract basis, money being supplied as needed by the organizers. When the system was put into operation a short time ago it was fully paid for, with no outstanding obligations.

Flood Causes Great Damage in Rondout Valley

An unprecedented flood in the narrow Rondout Valley, New York, Aug. 26 caused property damage estimated at several hundred thousands of dollars and the loss of three lives, according to preliminary reports. It is stated that twenty bridges were washed out and as many villages damaged. Highways, railroad tracks, light and telephone wires were affected to such an extent that communication was completely shut off from a number of settlements and summer resorts near the headwaters of the stream.

The valley affected is about 25 miles long and not more than 1 mile wide. Detailed reports of the damage done are not available at the time of going to press.

London Adopts $60,000,000 Plan to Relieve Congestion

The acceptance by the London County Council of a plan drawn up by the government Ministry of Transport paves the way for a $60,000,000 program of construction designed to relieve traffic congestion in the vicinity of Charing Cross. The project includes the removal of the Southern Railway station across the river, the construction of a new bridge, the rebuilding of the historic Waterloo bridge and the placing of an embankment along the Thames River to protect the new station. The English government will pay 75 per cent of the cost of the project, the remainder being paid by the London County Council.

Considerable discussion has been aroused by the various proposals concerning the Waterloo bridge. A committee of experts appointed by the government and the Institution of Civil Engineers recommended that the bridge be entirely reconstructed. The London County Council, however, decided that it should be altered to take six lines of traffic and should consist of not more than five arches. As the result of a public petition addressed to the Prime Minister, a royal commission was appointed to investigate the proposal. This commission reported that the bridge should be demolished, with the exception of two arches at either end, and that it should then be rebuilt to take four lines of traffic and also two 7½-ft. sidewalks. Although this recommendation has been adopted, it has been widely criticised. It is asserted that the reconstruction proposed will cost nearly $5,000,000, whereas an entirely new bridge to take six traffic lines could be constructed for a little more than $6,000,000.

Rainfall Records Broken

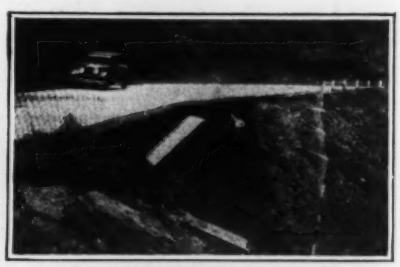
All records for rainfall were broken in Washington, D. C., this month by a total precipitation (up to Aug. 28) of 14.38 in., exceeding by 0.2 in. the previous record of August, 1906. Two unusually heavy storms occurred. On Aug. 11 and 12 8.67 in. of rain fell in a 40-hour storm, 6.64 in. of which were included in one 24-hour period. The most intense fall was 2.25 in. in 1½ hours. Again on Aug. 25 a second storm precipitated 1.68 in. of rain, 1.22 in. of which fell in one hour. The heaviest 24-hour fall recorded previously was 4.96 in., which occurred in 1898.

Many Canadian Bridge Projects Contemplated

A number of important bridge construction projects are under way, or in process of preparation, in various parts of Canada. In Quebec, plans have been completed and are now being studied by the provincial Department of Public Works for a vehicular bridge across the Richelieu River connecting Sorel with St. Joseph de Sorel. The sum of $800,000 has been appropriated for this project. Work is already proceeding on the $400,000 span across the St. Maurice River between Grand Mere and La Traverse, Que. Fraser, Brace & Company of Montreal have the contract. The Department of Public Works is also preparing plans for a vehicular road across the Quebec bridge to cost about $350,000.

The building of a steel bridge over the Saskatchewan River in western

FLOODS DAMAGE NORTH CAROLINA HIGHWAYS



Damage estimated at $300,000 was suffered by the North Carolina state highway system as the result of a heavy storm and resulting floods occurring on Aug. 15. On that date 4.42 in. of rain fell upon ground which was already thoroughly saturated. Routes 19 and 20, extending east and west through the state, suffered the greatest damage. None of the concrete bridges erected under state highway specifications were damaged or washed out, but considerable loss occurred to wooden structures and on account of slides. The pictures show a slide in Polk County on a 6-in. concrete pavement; a washed-out county bridge over Broad River (note superstructure in the stream), and an undermined section of plain concrete pavement in McDowell County. L. R. Ames, state highway engineer, states that within 48 hours traffic was being handled with very little inconvenience.

Canada is proposed by the Canadian Pacific Railway. According to the company's engineering department, the structure will be 1,840 ft. long, with an approximate height of 150 ft. There will be fifteen spans supported on steel towers carried by concrete pedestals. The abutments will also be of concrete. Double-deck construction is contemplated, with a 16-ft. highway on the lower tier. The bridge will be north of Nipawin, on the Tisdale subdivision.

WORLD'S FIRST SPHERICAL BUILDING

The building illustrated was erected for the Dresden Exposition of 1928, and is called "Die Technische Stadt" (The Technical Town). It has a diameter of 82 ft., is five stories (98½ ft.) high, contains about 268,000 cu.ft. and is a completely equipped office building with a coffee-room on the top floor. It has received much attention as being the probable building of the future.

Mexican Road Congress to Exhibit Machinery

Elaborate plans are being completed for the opening of the second National Road Congress of Mexico at Mexico City, Oct. 3-6. Delegates from all Mexican states will be present, as well as official representatives of most of the other Latin-American nations. The American Road Builders' Association, through its Pan-American Division, has accepted an invitation to participate and will invite engineers and officials from all sections of the United States.

In connection with the convention an elaborate exposition of road machinery, materials and equipment will be held. More than 50 manufacturers from the United States, Europe and Latin America will participate in the exposition, which will cover more than 120,000 sq.ft. of floor space.

The Mexican Road Congress is expected to have a far-reaching effect on relations between Mexico and the United States by stimulating road construction, and thus making Mexico easily accessible to American tourists. Delegates will be given an opportunity to inspect the methods of road construction and maintenance used in Mexico.

New Mexico Abolishes Local Speed Restrictions

Because traffic was being retarded, fines unjustly imposed and tourists severely criticizing both state and department, the New Mexico State Highway Commission has ordered all towns through which the federal aid system passes to abolish ordinances limiting speed to 10 or 15 miles per hour.

In many of the small settlements of the state the main artery of travel is a federal aid road which is part of the trunk system of the state. Probably with ideas of safety in mind many of these towns have enacted laws which reduce the speed of traffic down to an unwarranted minimum. Hereafter, before a project can be built through such a town the speed regulations must be raised to a minimum of 20 miles per hour. The practice of putting stop signs up on such projects where they pass through towns has also been frowned upon by the commission. Where signs now exist on federal roads they must be removed entirely or put on the intersecting streets.

Ottawa Will Vote on New Filter Plant Construction

The city council of Ottawa, Canada, has decided to submit to a vote of property owners at the next election in December a bylaw for the construction of a rapid sand filtration plant on Lemieux Island in the Ottawa River at an estimated cost of $1,315,000. The plant proposed is for a capacity of 34 m.g.d., and is considered of sufficient size to serve Ottawa until it reaches a population of 200,000. It will be constructed in units so that it may be enlarged at any time.

Cleveland Forms Highway Plan Board

Realizing that the political units composing a metropolitan district cannot develop a common highway system satisfactorily, civic and financial leaders of the Cleveland regional district have organized a highway research and planning bureau. This bureau, which is to be directed by J. Gordon McKay, who has been serving as chief of the division of highway economics of the Bureau of Roads, will supervise the carrying out of the recently approved $63,000,000 highway plan for the Cleveland metropolitan area.

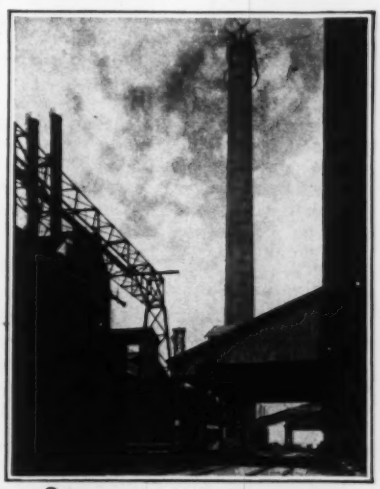
During the past six years the division of highway economics, under the leadership of Mr. McKay, has completed highway planning surveys in Connecticut, Maine, Ohio, Pennsylvania, New Hampshire and Vermont, and in the metropolitan areas of Chicago and Cleveland. Mr. McKay stated before he left Washington that although Cleveland is the first city to institute such work, highway and civic officials of other large centers are evincing great interest in the matter. Highway traffic knows no political boundaries, and highway planning should therefore be viewed on a regional basis, Mr. McKay pointed out.

The $63,000,000 program for the Cleveland regional area provides for a large amount of railroad grade separation as well as for the construction of new bridges and arterial highways. The civic and financial leaders sponsoring the new highway planning bureau have formed a regional highway committee composed of 41 members which acts through an executive committee. Associated with Mr. McKay in the work of directing this new bureau are O. M. Elvehjem, highway economist, Edward T. Stein and J. F. Hehir, all formerly connected with the Bureau of Roads.

Subway Bids Received

Bids were opened by the New York City Board of Transportation Aug. 28 for the construction of a section of the new subway near Prospect Park, Brooklyn. The section includes 7,860 ft. of track. There are two express and two local tracks, the former to be built by tunneling methods, while the latter, nearer the surface, are to be constructed by either open-trench or tunneling methods. Alternative bids were secured on four proposals: (1) concrete lining, tunnel construction; (2) cast-iron lining, tunnel construction; (3) concrete lining, trench construction; and (4) cast-iron lining, trench construction. The low bids for the four plans were, respectively: (1) $2,974,884, (2) $4,038,283.50, (3) $3,602,816.50, (4) $3,953,976.50. The first bid was submitted by the Cornell Contracting Company, the three others by the Hart & Early Company, Inc., both of New York City.

TALL CHIMNEY COMPLETED NEAR CHICAGO



This monolithic concrete chimney, 301½ ft. high, the tallest in the Chicago district, has just been completed at the Buffington (Ind.) plant of the Universal Portland Cement Company. It is 26½ ft. in diameter at the bottom and 17 ft. at the top. The wall thickness varies from 18 to 6 in. A single steel form 7½ ft. high was used in construction, one lift being poured each day. The contractor was the Rust Engineering Company, Pittsburgh, Pa.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Mississippi Contracts Awarded—Planning for Increase in Panama Canal Traffic—o Quiz Utilities

ANNOUNCEMENT of the award of levee contracts in the New Orleans district of the Mississippi River reveals that $536,007.40 of the work was assigned to private contractors, while work totaling $526,741 will be done with hired labor. The average price was slightly over 18c. per cubic yard for the work to be done under contract. In addition, $527,000 cu.yd. of work has been readvertised. The names of those awarded contracts, together with the yardage and the amount of the bid, are:

	Cu.Yd.	Bid
Don B. Hearin, Baton Rouge	38,000	$24,111
Dameron & Kenyon, Inc., Port Allen, La.	175,000	26,250
Dameron & Kenyon	93,000	14,617
O. O. Ogden	101,000	*8,412
O. O. Ogden	146,000	26,615
Lower Coast Construction Company, New Orleans	21,000	3,780
Lower Coast Construc. Company	14,000	2,520
Lower Coast Construc. Company	76,000	13,680
Lower Coast Construc. Company	142,000	25,560
Lewis Chambers Construction Company, New Orleans	520,000	111,800
Lewis Chambers Construc. Co.	290,000	52,142
O. O. Ogden	520,000	73,996
Lower Coast Construc. Company	29,000	5,220
Lower Coast Construc. Company	74,000	8,460
Lower Coast Construc. Company	74,000	13,320
Lower Coast Construc. Company	11,000	1,980
O. O. Ogden	60,000	9,738
O. O. Ogden	230,000	35,029
Callahan-Walker Construction Company, Omaha	50,000	12,000
New Construction Company, Mamou, La.	100,000	14,000
Sternberg & Company, St. Louis	116,000	23,200

Officers of the Corps of Engineers regard the bids on the projects awarded as having been particularly reasonable. In many instances they were less than the estimate of the Mississippi River Commission. On other projects, however, the bids exceeded the estimate of the commission by more than 25 per cent and, as a consequence, the work will be done with hired labor. On three projects there was reason to believe that bids that would come within that limit could be secured and these were advertised again.

Investigating Panama Dam Project

Representatives of the U. S. Geological Survey are en route to Panama to conduct foundation investigations in connection with the Alhajuela dam project in Panama. The proposed dam is to be 150 ft. high and will provide additional storage and hydro-electric power for use in connection with the operation of the Panama Canal. Actual work is expected to start this fall at the end of the rainy season. With the increase of traffic through the canal it has become necessary to provide against an unusually prolonged dry season. It practically has been decided to abandon the idea of constructing a railroad to the dam site. It is believed that the materials can be handled to advantage by truck. The 14 miles of highway which will have to be constructed will form a link in the interoceanic road.

There is no thought at present, it was stated at the office of the Panama Canal here, of extending the lockage period beyond the daylight hours. The present daily average of lockages is seventeen, but twenty-eight easily can be accomplished in twelve hours. It is admitted that some delays occur because vessels are not allowed to make the passage at night, but it is pointed out that the navigation hazard would be increased, as would the cost of dredging. At present dredging is done at night.

Hell Gate Channel Work

Because of complaints from property owners in the region it may be necessary to reduce charges of dynamite below the 800 lb. limit now in effect in Hell Gate channel. If a reduction is made, the Corps of Engineers plans to increase the pay of the contractor engaged in ledge rock removal in the following ratio:

$$\frac{3}{4} \times \frac{c'}{c} \times \frac{3b}{5}$$

In this formula c' = amount of reduction in quantity of explosive; b = contract unit price; c = maximum quantity of rock specified.

Geological Survey Investigations

The U. S. Geological Survey will open a district office on Sept. 1 at Tuscaloosa, Ala. This office will be under the direction of C. E. McCashin, district engineer, with Paul E. Hanson as principal assistant. The work from this office will consist in studying the surface water resources of Mississippi and Alabama, to the end that the necessary base data may be made available for use in the design, construction, operation and administration of works needed in connection with flood control, power, drainage and navigation. The data will also have special value in connection with problems relating to municipal and industrial water supplies. Fifty river measurement stations, now in operation, will be administered from this office, and other stations will be installed. The investigations will be carried on in cooperation with the Corps of Engineers and other federal agencies, with the states, and with permittees and licensees of the Federal Power Commission. The establishment of the office at this time has been due to the demand for additional data by those agencies which are engaged in connection with the solution of the flood problems in the Mississippi River Valley.

John C. Hoyt, hydraulic engineer, U. S. Geological Survey, on Aug. 27 started on a general inspection trip through the Western states. On this trip he will visit the district offices of the Survey at Denver, Colo.; Salt Lake City, Utah; Idaho Falls, Idaho; Tacoma, Wash.; Portland, Ore.; San Francisco and Los Angeles, Calif.; Topeka, Kan., and Rolla, Mo. From these offices the Geological Survey is conducting general investigations needed for determining the basic data required in the design, construction, operation and administration of works which depend upon adequate water supplies for their successful operation. These include irrigation, power, drainage, navigation, flood control and municipal and industrial water supplies. The investigations are conducted in co-operation with federal and state governmental agencies and with private individuals and corporations which are operating under governmental regulations. Special studies are now being made on Western streams in connection with the division and administration of interstate and international waters. Important problems for which investigations are now being conducted in this connection are on international streams between the United States and Canada; the Rio Grande, between the United States and Mexico; and the Columbia and Colorado rivers, both of which have interstate and international problems.

Mr. Hoyt is vice-president of the American Society of Civil Engineers, and will attend the fall meeting of the society at San Diego, Calif.

Preparing Utilities Questionnaire

Delays in the Government Printing Office have prevented the Federal Trade Commission from sending out its 210-page questionnaire to the electric and gas utilities. The commission has made available, however, the index to the schedules and such of the schedules as have been printed. The printed portion of the questionnaire indicates that it is of a most detailed character and justifies the estimates that the response will cost the utilities many millions of dollars. In all there are 78 schedules.

As the study of the files of some of the information bureaus in the Far Western states has not been completed, it seems probable that the hearings will not be resumed until late in September.

Dredging Pearl Harbor

The work of dredging Pearl Harbor, T. H., is progressing rapidly and will be completed next spring. Contracts totaling $6,000,000 have been let to the Hawaiian Dredging Company and the United Dredging Company. The channel and adjacent areas are being dredged to depths varying from 35 to 45 ft., which will permit the ingress and egress of the largest naval vessels.

Power Licenses

The Champion Sillimanite Company, Inc., of Bishop, Calif., has applied to the Federal Power Commission for a license covering a water-power project on Milner Creek, near Bishop. It is proposed to divert the entire natural flow of the creek through a conduit 10,000 ft. long to the power house, operating under an 880-ft. head. In this way 225 hp. will be developed for use in the mining property of the applicant.

The commission has issued a license to the Bunker Hill & Sullivan Milling & Mining Company which allows it to construct a 350-hp. plant on the Deadwood River, near its mining property.

Engineering Societies

CALENDAR

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Montreal, Canada, Sept. 18-21.

NATIONAL SAFETY COUNCIL, Chicago; Annual Meeting, New York City, Oct. 1-5.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Fall Meeting, San Diego, Calif., Oct. 3-5.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Convention, Detroit, Mich., Oct. 22-28.

THE OHIO VALLEY IMPROVEMENT ASSOCIATION will hold its annual convention at Pittsburgh, Pa., on Oct. 3 and 4. Among the principal topics to be discussed will be the development of tributaries of the Ohio River, the development of terminals and formal dedication of the Ohio River navigation facilities to take place next year. Speeches will be made by Secretary of War Dwight Davis, Major Gen. Edgar Jadwin, Chief of Engineers, and Gen. T. Q. Ashburn, executive chairman of the Inland Waterways Corporation. W. C. Culkins is secretary of the association.

THE AMERICAN WATER WORKS ASSOCIATION, Central States Section, held a meeting at Huntington, W. Va., Aug. 23-24. A number of interesting papers were on the program, among which may be mentioned the following: "Some Unusual Conditions Discovered Through Pitometer Water Waste Surveys," by H. E. Beckwith, Harrisburg, Pa.; "Laboratory Aids in Control of Coagulation and Filtration," by Martin E. Flentje and Gerritt S. Buchanan, supervising engineers of the Community Water Service Company, New York City; "Progress in Sanitary Engineering in West Virginia," by E. S. Tisdale, chief engineer, State Department of Health, Charleston, W. Va.; "Water-Softening Plant at Marion, Ohio," by George Whysall, manager of the Marion Water Company, Marion, Ohio.

Officers were elected as follows: President, D. C. Grobbel, Detroit, Mich.; vice-president, E. E. Bankson, Pittsburgh, Pa.; secretary and treasurer, J. S. Dunwoody, Erie, Pa.

THE NATIONAL RESEARCH COUNCIL, Highway Research Board, will hold its eighth annual meeting Dec. 13-14, in Washington, D. C.

THE NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS will hold its annual convention Nov. 19-20 at Little Rock, Ark.

THE AMERICAN SOCIETY OF CIVIL ENGINEERS, San Francisco section, held its regular bimonthly meeting on Tuesday, Aug. 21. The paper of the evening was "The Upper San Leandro Project of the East Bay Water Company," by George W. Hawley, engineer in charge, water-supply investigations and construction, East Bay Water Company.

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA, executive board, advisory board and president's council will meet in Minneapolis, Minn., on Sept. 24-26.

THE WESTERN PUBLIC WORKS CONTRACTORS' ASSOCIATION recently inspected the Diablo power project as guests of the Seattle, Wash., light department.

Brief News

THE STONY GORGE STORAGE DAM of the Orland, Calif., irrigation project will be completed in September, two months ahead of schedule. The dam is of the hollow type, with reinforced-concrete face slab and concrete buttresses. It has a maximum height of 120 ft., a crest length of about 900 ft. and cost approximately $1,000,000.

THE WAITING ROOMS, concourse and attendant facilities of the new North Station of the Boston & Maine Railroad at Boston, Mass., have been put into service, although the entire building is not expected to be completed until November.

OFFICIAL GROUND-BREAKING CEREMONIES for the new Kill van Kull bridge between Bayonne, N. J., and Port Richmond, Staten Island, will be held Sept. 18. The first contract for the structure, covering the abutments, has already been awarded, as noted in *Engineering News-Record*, July 19, 1928, p. 111.

CONSTRUCTION OF THE LAST SECTION of cofferdam of Dam No. 5 on the Ohio River has been started by the U. G. I. Contracting Company. Completion of this dam, which is scheduled for next year, will finish the government navigation project for the entire distance from Cairo to Pittsburgh.

A NEW 1,500-FT. WHARF has been completed at New Orleans, La., for the Todd Engineering, Dry Dock and Repair Company, in preparation for the expected arrival of a 12,000-ton electrically driven drydock. The wharf is equipped with railroad tracks and a 15-ton traveling crane.

GRADUATE FELLOWSHIPS in sanitary, hydraulic or structural engineering are available at the University of Minnesota for the coming academic year. Applicants should be civil engineering graduates qualified to pursue advanced study. About half time will be devoted to research and teaching service, while the other half is free for graduate work. Further information may be obtained from the Department of Civil Engineering, University of Minnesota, Minneapolis, Minn.

Personal Notes

M. O. ELDRIDGE, assistant traffic director of the District of Columbia, is now chairman of the traffic committee, city officials division of the American Road Builders' Association. The committee will study all problems related to city traffic.

Lieut. Comdr. GEORGE B. WETSEL, Civil Engineer Corps, U. S. Navy, has been ordered to the Puget Sound Navy Yard. He has been supervising the $6,000,000 dredging contract at Pearl Harbor, T. H.

JOHN C. WORTHINGTON has joined the organization of Black & Bigelow, Inc. His work will include a variety of duties such as inspection of airplanes, selection of operating bases, and engineering duties connected with airport construction and site selection.

W. BEAUREGARD DAVEY has been appointed acting assistant engineer in charge of the New Orleans Parish Levee Board. He will be assisted by Edward Hyatt, assistant engineer in charge of lakeshore work, and Henry L. Zander. The appointments were made by Governor Long of Louisiana.

D. S. REID, president of the D. S. Reid Construction Company, Littleton, Colo., is planning to combine construction work with mining by using a dragline outfit to excavate about 1,000 cu.yd. of dirt daily, from which it is estimated that $3 in gold per cubic yard will be recovered.

GEORGE B. WRIGHT, county superintendent of highways of Rochester, N. Y., has been appointed chairman of the committee on urban county highway maintenance of the county highway officials division, American Road Builders' Association.

W. D. BARKHUFF has been appointed city engineer of Seattle, Wash., to succeed W. Chester Morse, resigned. Mr. Barkhuff was formerly bridge engineer in the city engineer's office.

WILLIAM B. SEVERYNS, former chief of police of Seattle, has been appointed superintendent of water for that city.

D. B. LEVI has been appointed construction engineer for the Missouri Highway Department to succeed Ray Dunlap, who resigned recently to become city engineer for St. Joseph, Mo. Mr. Levi had been division engineer at St. Joseph. J. J. Corbett, assistant engineer of surveys and plans, has been promoted to the position formerly held by Mr. Levi.

HERBERT CHATLEY has been appointed engineer-in-chief to the Whangpoo Conservancy Board (Shanghai) in place of Capt. H. v. Heidenstam, who has resigned.

Construction Equipment and Materials

Moving a Large Industrial Plant

More than $2,000,000 worth of tools and equipment of the De La Vergne Machine Company, one of the subsidiaries of Cramp-Morris Industrials, Inc., of Philadelphia, is being moved from New York City to the old marine machine shops of the Walter Cramp & Sons Ship & Engine Building Company, which have been idle since 1926. The De La Vergne company is one of the oldest manufacturers of refrigerating machinery and Diesel engines in the country. It has occupied its present situation in New York City for about 40 years, but is now being moved to Philadelphia as a step in the consolidation of the Cramp-Morris companies.

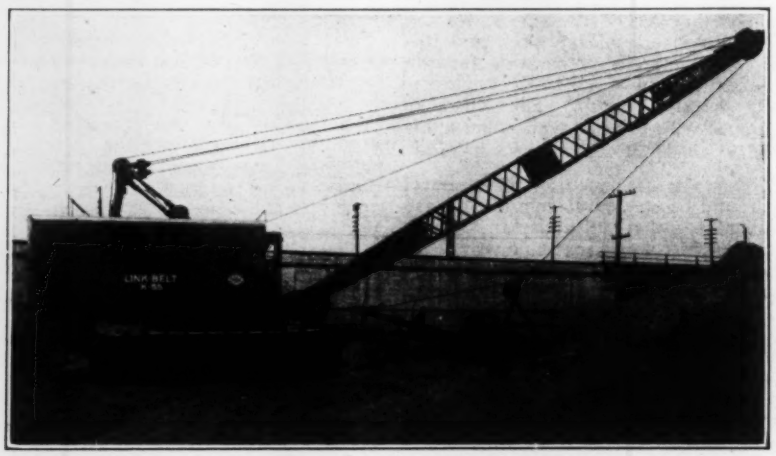
During the move, manufacturing is being carried on without interruption. At the present time production is about equally divided between New York and Philadelphia. By November it is expected that all work will be done in the Philadelphia plant.

New Developments

Two-Yard Shovel Announced

The addition of a 2-yd. capacity unit to its line of excavating machines has been announced by the Link-Belt Company, Chicago, Ill. Heretofore the largest machine built by this company was a 1½-yd. unit. The new K-55 machine may be used as a shovel, a dragline, a trench shovel or with a 2-cu.yd. clamshell bucket. All attachments are interchangeable without removing or disturbing the mechanism of the machine proper. The power source is by gasoline engine, electric motor or Diesel engine. The machine in working condition is 12 ft. wide over all at the lower frame, with crawler treads 36 in. wide. By means of special shipping treads substituted for the working treads, it is possible to bring this unit within a standard railroad clearance when loaded on a flat car, so that it can be transported without dismantling.

The main friction clutch is 42 in. in diameter; the wing and tread clutches 30 in. Large drums with renewable cast-steel shells are used, having an air space between the clutch and brake surfaces for rapid cooling. The 13½-in. center pin is adjustable from above and can be removed as a unit. When used as a shovel, the machine carries a 30-ft. boom and 18-ft. dipper stick, carrying a 2-cu.yd. manganese-steel dipper. The dragline boom is 59 ft. long for a 2-cu.yd. bucket, or 60 ft. long for a 1½-cu.yd. bucket. When rigged with a clamshell, the manufacturer recommends a 60-ft. boom with a 2-cu.yd. bucket for sand, gravel or similar materials; or a 1½-cu.yd. bucket for heavier excavation.

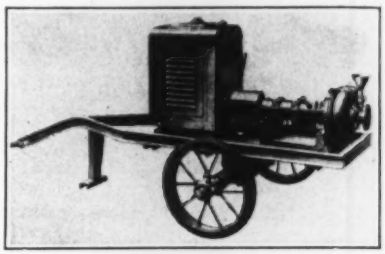


Manganese Steel Used on Wearing Parts of New Pumping Units

A series of portable pumping units, using manganese steel for the shell, impeller and disks where shock, wear and abrasion are encountered, has been developed by the American Manganese Steel Company, Chicago. A long, ring oiling, babbitted sleeve bearing supports the shaft to which the impeller is press-fitted. The drive shaft is lubricated by a large oil reservoir which also lubricates the thrust bearing. The entire unit is solidly mounted on a base plate and is connected with a flexible coupling through a friction clutch to the Novo power unit operating at 1,200 r.p.m.

The frame is made of 3-in. channels electrically welded. A sturdy arm supports the forepart of the frame, steadying the load when the carriage is stationary. Spring shock absorbers on the axle cushion the jars and blows received in transit, and roller bearing rubber-tired wheels insure easy handling.

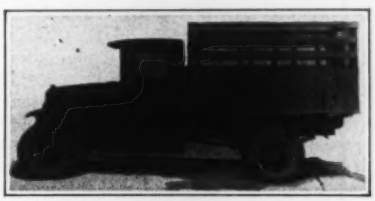
These portable pumping units are made with 2-, 2½- and 3-in. discharge powered by 6-, 8- and 10-hp. engines respectively. The 2-in. unit has a pumping capacity of 100 g.p.m. against a



34-ft. lift with no horizontal discharge hose, and it will maintain the same capacity through 125 ft. of 2-in. hose without vertical lift. The 2½-in. unit has a pumping capacity of 150 g.p.m. against a 34-ft. lift with no horizontal hose, or through 150 ft. of 2½-in. hose with no lift. The 3-in. unit has an approximate capacity of 230 g.p.m. against a 37-ft. lift with no horizontal hose on the discharge end. It has an equal capacity with no lift and when discharging through 200 ft. of horizontal hose.

A Six-Speed 1-Ton Truck

To meet the demand for a small, heavy-duty truck which will make high speed on good roads and at the same

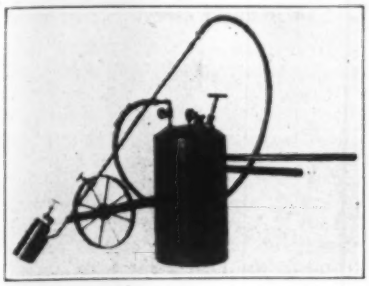


time pull through unusually heavy mud or sand, the International Harvester Company has brought out a new model called the "Six-Speed Special." This is a 1-ton unit equipped with a two-speed spiral bevel rear axle and the conventional three-speed and reverse transmission. The effect of the special axle is to give an equivalent of six forward speeds with two reverse. It is intended that the higher speeds be used for fast hauling, with the low range held in reserve for rough roads, mud and similar hard going.

Wheel-Mounted Kerosene Torch

Increasing use of kerosene torches in a multitude of industrial, railway and highway services has resulted in production of these torches with large capacity tanks which are too heavy for one-man operation. To avoid necessity for the employment of two men in using

such kerosene burners, the Chausse Oil Burner Company, of Elkhart, Ind., has announced a model arranged similarly to a wheelbarrow. This outfit can be easily transported by the man who re-



quires it in his occupation. A conventional type welded steel tank with capacity of 14 gal. of kerosene is mounted in tubular steel shafts with a single wheel. To the tank, which has a self-contained air pump and pressure gage, is attached the kerosene burner by means of heavy-duty pneumatic tool hose. The burner handle is steel, with wooden grip and convenient needle valve.

This burner is self-generating and produces a heat temperature from 1,750 to 1,800 deg. F. The volume of gas is considerable and makes this outfit adaptable to such work as preheating prior to welding, thawing frozen piping, melting snow on tracks and switches, and wherever an intensely hot flame is desired.

Business Notes

W. D. STARRETT METAL CUTTING PRODUCTS COMPANY has appointed as its representative the Morse-Starrett Products Company, Oakland, Calif.

BACON, HIBBARD, EICHMAN, INC., is the name of a new firm in the contractors' equipment field in Cleveland, Ohio. This company is a consolidation of the Bacon Engineering Sales Company and of the partnership of Eichman & Hibbard. The new firm will deal in mixers, pavers, elevators, conveyors, power shovels, motor trucks, pumps, hoists, saw rigs, steel bins, forms, compressors, pneumatic tools and miscellaneous machinery, small tools and accessories.

THE WAGNER ELECTRIC CORPORATION, St. Louis, Mo., announce the addition of Charles J. Arthur to its Philadelphia office as a salesman. Mr. Arthur was, until recently, sales engineer for the A. R. Amos, Jr., Company, of Philadelphia.

Manufacturers and Trade Associations

CALENDAR

ANNUAL MEETINGS

TRACK SUPPLY ASSOCIATION, Chicago; annual exhibition and convention, Detroit, Sept. 18-20, 1928.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; semi-annual meeting, Buckwood Inn, Shawnee-on-Delaware, Pa., October 1-3, 1928.

New Publications

Oil Tank Roofs—CHICAGO BRIDGE & IRON WORKS, Chicago, Ill., devotes a new 24-page catalog to its Wiggins floating roofs for oil tanks. The title of the catalog is "Stopping Evaporation and Fire" and descriptions and data given are largely in line with these features of the roof.

Motor Graders—GOOD ROADS MACHINERY COMPANY, INC., Kennett Square, Pa., illustrates and describes its various types of motor graders in a new 15-p. catalog. Models are shown using the Cletrac model 20-K tractor, the 2-ton Caterpillar, and the McCormick-Deering 10-20 tractor as power units. Tables of specifications are given for the various models, which are furnished with either crawler or rubber tire mountings.

Activated Sludge Process—SIMPLEX EJECTOR & AERATOR CORPORATION, Chicago, Ill., has published a catalog describing its equipment for use with its surface aeration process of sewage treatment by activated sludge. In Section A the Simplex process is described and line cut drawings and halftone illustrations are shown of a number of installations. In Section B the company's aerator for water-treatment plants is illustrated. Section C is devoted to the pneumatic sewage ejector, Section D to sludge-pressing apparatus and Section E to automatic and stationary screens, hand stops and general fittings. A list of plants both in the United States and in England and Europe, in which the company's equipment is being used, is included.

Working With Air—INGERSOLL-RAND COMPANY, New York City, has published a new edition of its book entitled "100 and 1 Ways to Save Money With Portable Compressors." As in the previous edition, the booklet is filled with useful information. Many illustrations of the use of the company's air tools are shown, and not only are descriptions of construction methods given but considerable cost data on various construction jobs are included. Illustrations and specifications of the company's various portable compressors and the tools which they operate form a part of the book, which contains 112 pages.

Excavating Machinery — DAYTON-WHIRLEY COMPANY, Dayton, Ohio, has issued a new descriptive catalog of Wiley-Whirley draglines, clamshells and cranes. The 16-page book is profusely illustrated to show details of construction and actual performance under various conditions. Specifications are given in tabular form.

MODERN EQUIPMENT ON TWO CURRENT JOBS

At the left is shown the ultimate in crawler mounted equipment. The scene is a state highway project near Graham, N. C., where Nello L. Teer, contractor, is moving 1,000 cu.yd. of dirt per day, using two Caterpillar Sixty tractors with Biehl crawler wagons and a Northwest crawler shovel. The train of equipment shown in the right-hand illustration is said to be moving 50 cu.yd. of material per hour a distance of 500 ft. on the new Hogg's Hollow bridge at Toronto, Canada. A Caterpillar tractor is pulling five Baker-Maney scrapers.

The Business Side of Construction

Cost of Living in the United States

Changes in the cost of living are of vital interest, not only to all consumers and particularly to the wage-earning classes but also to employers in all fields, whether in business pursuits, in educational institutions or in public service generally. The consumer has the problem of adjusting his manner of living to his income, or his income to his manner of living; the employer has had to make adjustments in his wage and salary payments and to find the resources with which to do so. For these reasons the studies in the cost of living in the United States since 1914 which have just been completed and made public by the staff of the National Industrial Conference Board are of primary interest.

Complaint of the high cost of living was general even before the outbreak of the World War, but the situation did not become acute until the rapid rise in prices induced by the war and the subsequent economic adjustments caused deep-seated economic distress which transferred the question of the cost of living from one of largely academic interest to a practical problem of daily life. The cost of food, housing, fuel and light, clothing and sundries rose to varying heights never before obtained in this nation, and the producer and the consumer, the employer and the employee were called to adjust themselves to meet these rapidly changing conditions. The cost of living reached its peak in June, 1920, a year and a half after the close of the war, and in the following months the decline was rapid, the low point being attained in August, 1922, when the cost of living was 24.5 per cent under the peak of June, 1920. Since that time considerable stability has been shown in the items entering into the cost of living index, it being at present about 3.2 per cent above the minimum of August, 1922, but about 31.5 per cent under the peak of June, 1920. There are many reasons for believing that the cost of living will continue fairly stable for some time to come.

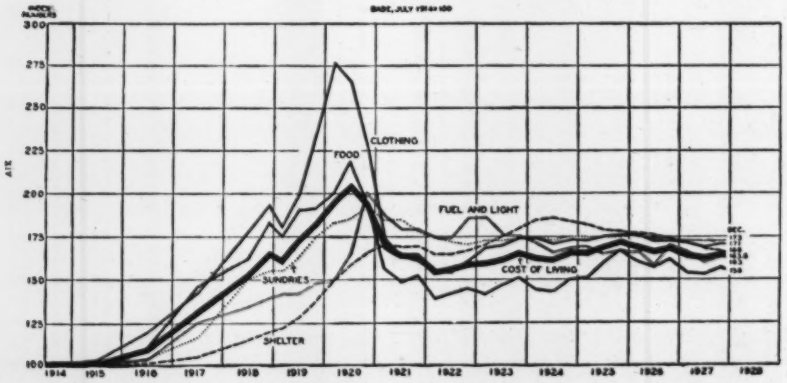
As the cost of living has advanced and declined the trend in the purchasing power of the dollar has been reversed—declined and advanced. If prices rise, the quantity of goods which can be purchased with one dollar diminishes and the purchasing value of the dollar falls. In like manner, should prices fall, the purchasing value of the dollar would rise. In June, 1920, when the cost of living was the highest, the purchasing power of the American dollar was only 48 per cent of its 1914 value. By August, 1922, the purchasing value had advanced to 64 per cent, and at the present time the 1914 dollar is worth about 62 cents in so far as its actual purchasing power is concerned. It is probable that the purchasing power of the dollar will stabilize close to its present level.

E. N.-R. Index Numbers

	Cost		Volume	
Aug. 1, 1928	**207.29**	**July, 1928**	**266**
July 1, 1928	206.65	June, 1928	308
Aug. 1, 1927	205.50	July, 1927	252
Average, 1927	206.24	Average, 1927	263
Average, 1926	208.03	Average, 1926	228
1913.....	100.00	1913.....	100

New Construction Continues Above Last Year

The week ended Aug. 28 witnessed a volume of new construction, as indicated by the value of contracts let, some 34 per cent above the same week last year. This is one of the largest gains reported so far this year and is 20 per cent above the average twelve-month gain recorded since the opening of the year. The feature of the week was in the value of contracts let for commercial buildings, which totaled $51,173,000, as against $27,846,000 for the same week last year, or a gain of 84 per cent, while the value of contracts let for industrial buildings was triple that recorded during the same week last year. Large gains were also reported for sewers, excavations and streets and roads. Contracts let for water-works, bridges and federal government projects were, on the other hand, materially under last year.



THE PRESENT COST OF LIVING IS ABOUT 31.5 PER CENT UNDER THE PEAK OF 1920

Cost of Rent Lowest Since 1920

Of special interest to the building construction industry is the subject of rents. To a considerable degree, rents are the reflection of new building construction, although retail cost of food, clothing and other commodities also play a large part in the rental that must be paid for residential, commercial and industrial quarters. According to the U. S. Department of Labor, the cost of rents at present is the lowest since 1920. The present index, referred to 1913, is 158, against 168 in 1924, the peak year of rental costs. The trend has been downward constantly since 1924. Some economists believe, however, that a point of comparative stability has now been reached and that rents will continue around 58 per cent over the pre-war figure.

Some Current Bond Offerings

Buildings	Amount	Interest Rate, Per Cent	Yield, Per Cent
Beaver Ave. Pres. Church, Des. Moines, Ia.....	$200,000	5½	5½
Central Oakland Block, Oakland, Calif.....	1,500,000	6	6
Gulf States Paper Corp....	2,500,000	6½	6½
National Company, Ann Arbor, Mich.....	250,000	5½	5½
Nebraska-Iowa Bridge Corp.	650,000	6½	6½

Trend of Profits in 1928

Profits of general business corporations for the first six months are somewhat higher than for the first six months of 1927, according to the National Bank of Commerce of New York. The statements now available for 310 companies show this increase to be 8 per cent. Of these 310 companies, 190 have had larger incomes in the first half than in the same period a year ago, while 120 reported smaller earnings. That the second quarter of the current year registered marked improvement over the first is indicated by a comparison of each quarter with the corresponding period of 1927. Some 213 industrial companies reported no increase in earnings during the first quarter over last year, whereas in the second quarter there was an increase of 19 per cent.

This Week's Contracts

Heavy constuction contracts, reported by *Engineering News-Record* in the week ended Aug. 28, with some comparisons, total as follows:

(In Thousands of Dollars, 000 Omitted)

Week Ended	Public	Private	Total
Aug. 28, 1928	**$29,784**	**$30,355**	**$60,139**
Aug. 21, 1928	28,611	60,892	89,503
Aug. 29, 1927	23,155	49,774	72,929
Jan. 1 to Aug. 28:			
1928.....	908,322	1,490,390	2,398,713
1927.....	843,478	1,274,424	2,117,902